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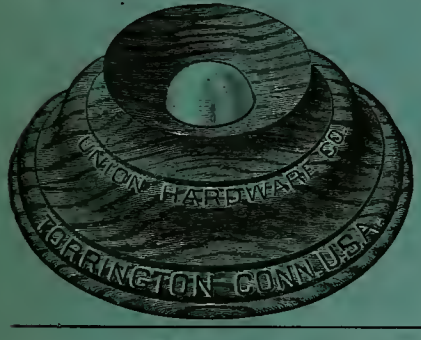

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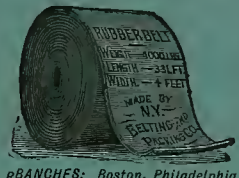

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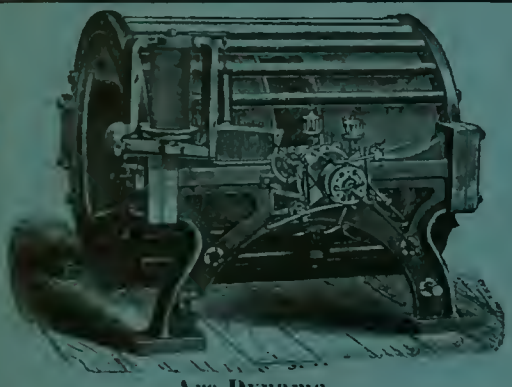

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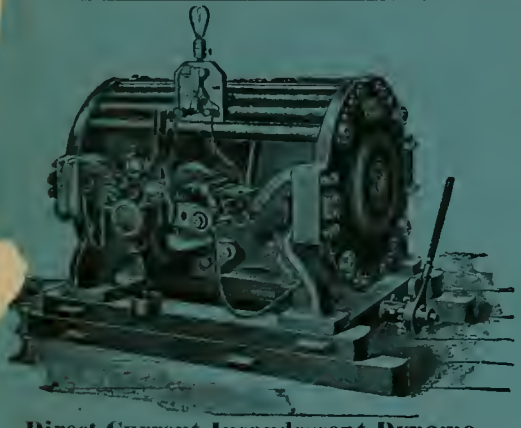

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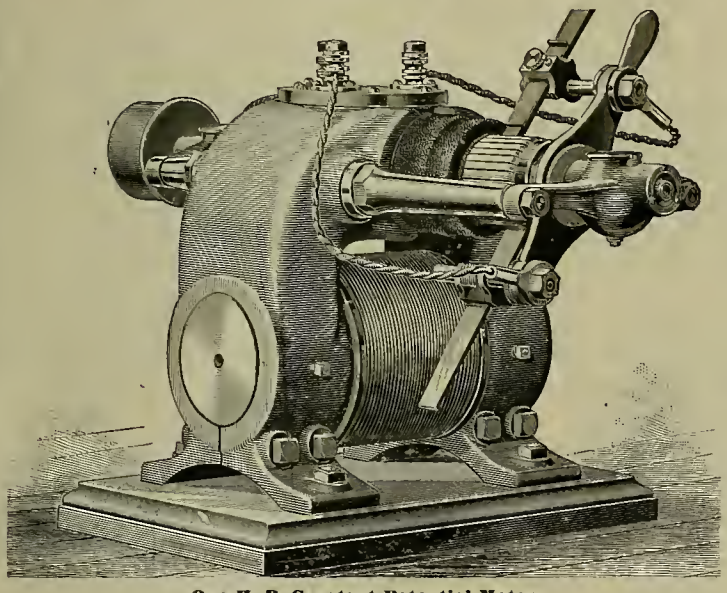

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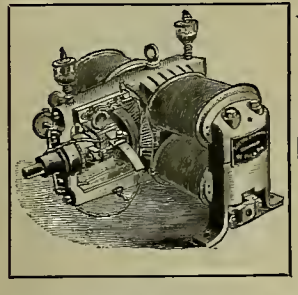

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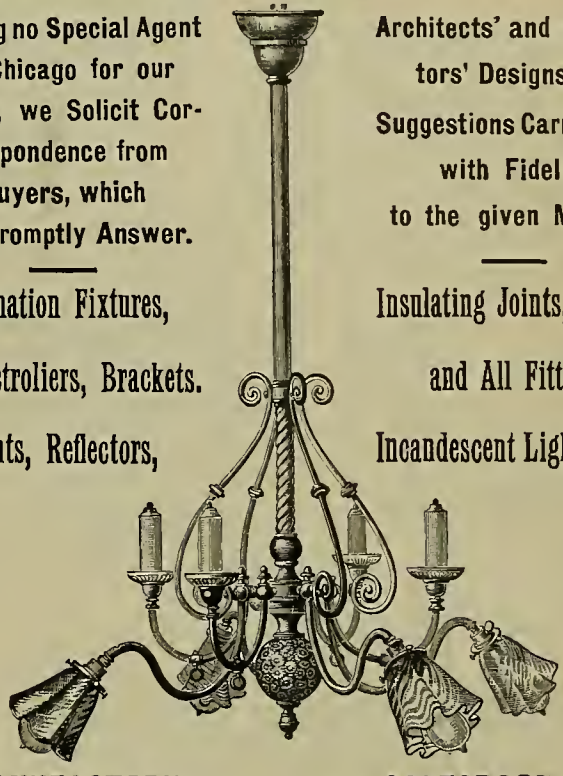

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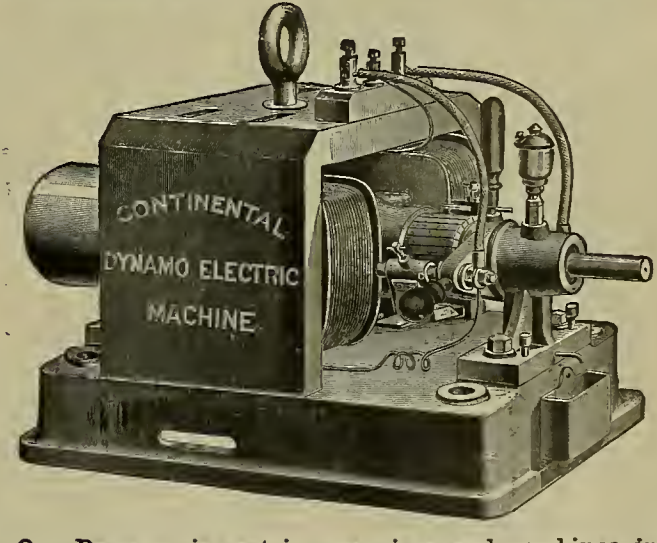

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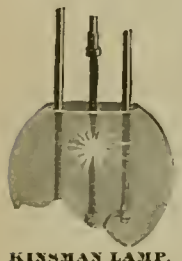

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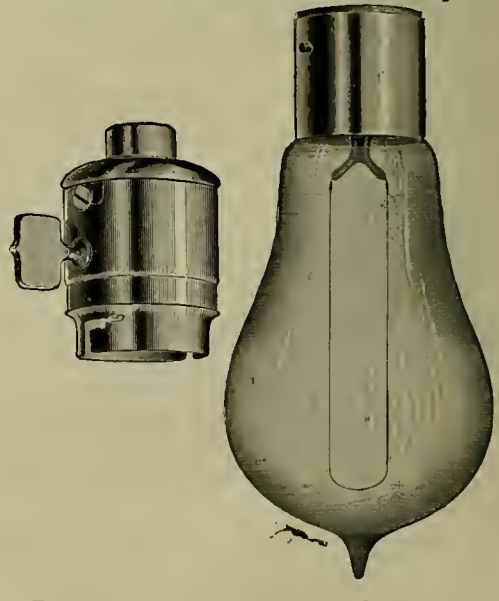

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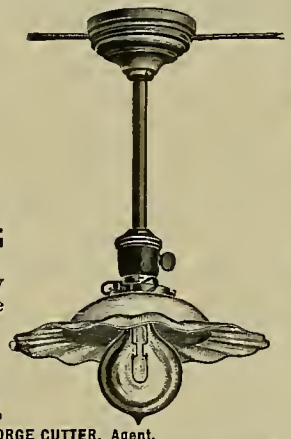

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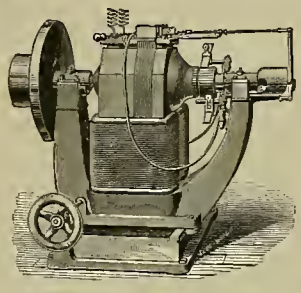

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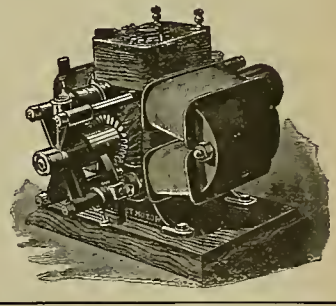

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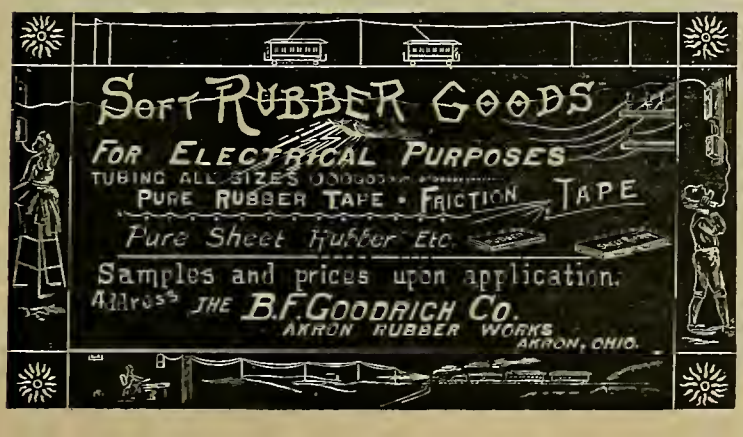

THE BEGINNING OF THE END.

EDISON COMPANY SUSTAINED.

WESTINGHOUSE COMPANY DEFEATED.

Sawyer-Man Patent Decided by the Court to be a Fraud and Absolutely Valueless.

EXTRACTS FROM THE DECISION OF JUSTICE BRADLEY, OCTOBER 5, 1889.

Circuit Court of the United States,
For the Western District of Pennsylvania.

THE CONSOLIDATED ELECTRIC LIGHT COMPANY (Westinghouse Company),

VS.

McKEESPORT LIGHT COMPANY (Edison Company)

No. 5 May Term, 1888.

ON BILL AND FINAL HEARING.

OPINION OF THE COURT.

BRADLEY, Circuit Justice:

....."The great question in this suit is, whether the patent sued on is valid, so far as involves a general claim for the use in electric lamps of incandescing carbon conductors, made of fibrous or textile substances. If it is, the complainant must prevail. If it is not, the bill 'must be dismissed.' "

....."Is the patent valid for such a broad claim? The defendants contend that it is not. First, because no such invention was set forth in the original application, but was introduced more than four years after it was filed, and after the same material had been used by Edison and claimed by him in application for a patent. Secondly, because Edison, and not Sawyer-Man, was really the original and first inventor of an incandescent conductor made of fibrous or textile material for an electric lamp."

....."It is very clear to us that in the original application for the patent sued on, the applicants had no such object in view as that of claiming all carbon made from fibrous and textile substances as a conductor for an incandescing electric lamp. Nothing on which to base any such claim is disclosed in the original application; we have carefully compared it with the amended application on which the patent was issued, and are fully satisfied that after Edison's inventions on this subject had been published to the world there was an entire change of base on the part of Sawyer & Man, and that the application was amended to give it an entirely different direction and purpose from what it had in its original form."

....."By an adroit amendment made in 1885, they say, 'Our improvement relates more especially to the incandescing conductor, **its substance**, its form, and its combination with the other elements composing the lamp.' The purpose of this amendment is obvious and needs no comment."

....."The fact is that Sawyer & Man were unconscious that the arc was not new, and supposed that they could get a patent for it; but as their eyes were opened, they changed about and amended their application, and made the material of the conductor the great object — carbon made from fibrous and textile material. Compare the original with the amended application, as first stated in this opinion, and this purpose most obviously appears."

....."The fact that the whole object of the application was changed, is evinced by the correspondence of the parties."

....."This testimony of Mr. Broadnax, which is undoubtedly to be relied on, in connection with the letter just quoted, shows that the idea of claiming carbons made from fibrous and textile materials was an after-thought, and was no part of the purpose of the original application. The amendments relating to this new and broad claim were made afterwards, in February and March, 1885.

"We are of the opinion that the changes made in the application in this regard were not justifiable, and that the claim in question cannot be sustained."

....."We are not at all satisfied that **Sawyer & Man** ever made and reduced to practical operation any such invention as is set forth and claimed in the patent in suit. Their principal experiments were made in 1878, and perhaps the beginning of 1879. The evidence as to what they accomplished in the construction of electric lamps is so contradictory and suspicious that we can with difficulty give credence to the conclusions sought to be drawn from it. **We are not satisfied that they ever produced an electric lamp with a burner of carbon made from fibrous material or any other material which was a success."**

....."**The application for the patent in suit was not made until January, 1880, nearly or quite a year after all their experiments had ceased, and after the inventions of Edison had been published to the world."**

....."**The explanations made by the complainants for the delay in applying for the patent in suit, fail to satisfy our minds that Sawyer & Man, or their assignees for them, have not sought to obtain a patent to which they were not legitimately entitled.**

"But suppose it to be true, as the supposed inventors and some of the other witnesses testify, that they did in 1878, construct some lamps with burners of carbon made of fibrous material and of an arched shape, which continued to give light for days or weeks, or months; still, were they a successful invention? Would any one purchase or touch them now? Did they not lack an essential ingredient which was necessary to their adoption and use? Did they go any further in principle, if they did in degree, than did other lamps which had been constructed before? It seems to us that they were following a wrong principle—the principle of small resistance in an incandescing conductor, and a strong current of electricity; and that **the great discovery in the art was that of adopting high resistance in the conductor with a small illuminating surface and a corresponding diminution in the strength of the current. This was accomplished by Edison in his filamental thread like conductors, rendered practicable by the perfection of the vacuum in the globe of the lamp.** He abandoned the old method of making the globe in separate pieces, cemented together, and adopted a globe of one entire piece of glass, into which he introduced small platinum conductors, fastened by fusion of the glass around them, thus being able to procure and maintain perhaps the most perfect vacuum known in the arts. In such a vacuum the slender filaments of carbon attenuated to the last degree of fineness, may be maintained in a state of incandescence without deterioration, for an indefinite time, and with a small expenditure of electric force. **This was really the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purposes of general use in houses and cities."**

....."**The principal and great thing described is the attenuated filament, and its inclosure in a perfect vacuum."**

....."**We think we are not mistaken in saying that but for this discovery electric lighting would never have become a fact. We have supposed it to be the discovery of Edison, because he has a patent for it. This may not be the case; it may be the discovery of some other person. But whoever discovered it, it is undoubtedly the great discovery in the art of practical lighting by electricity."**

....."**The bill must be dismissed."**

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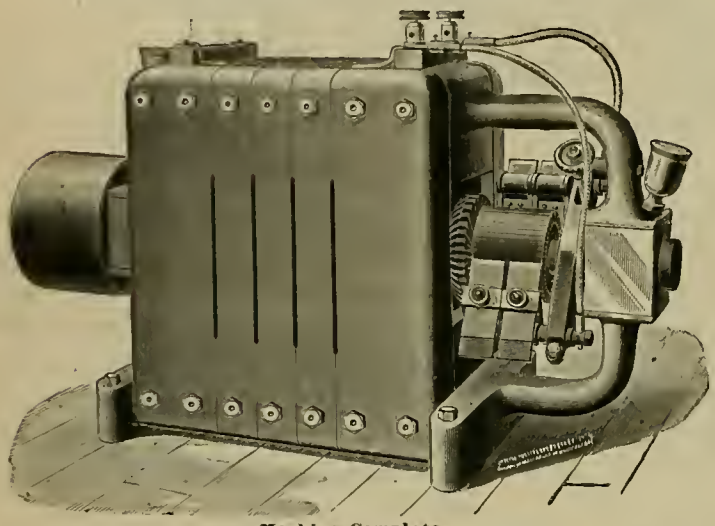

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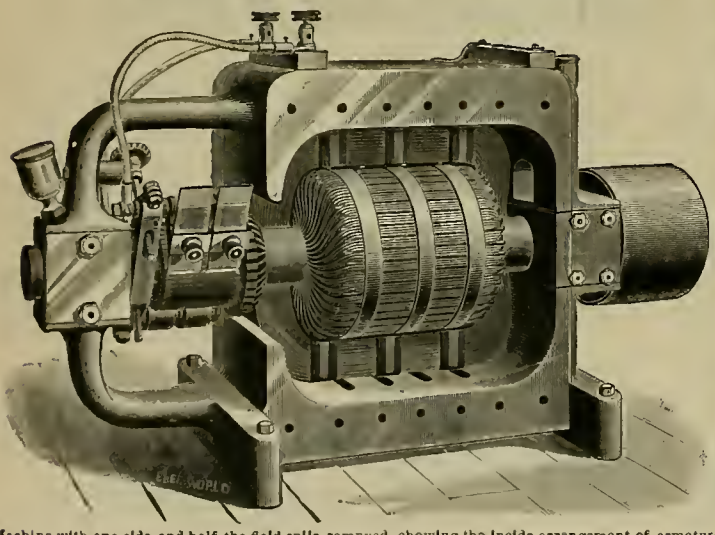

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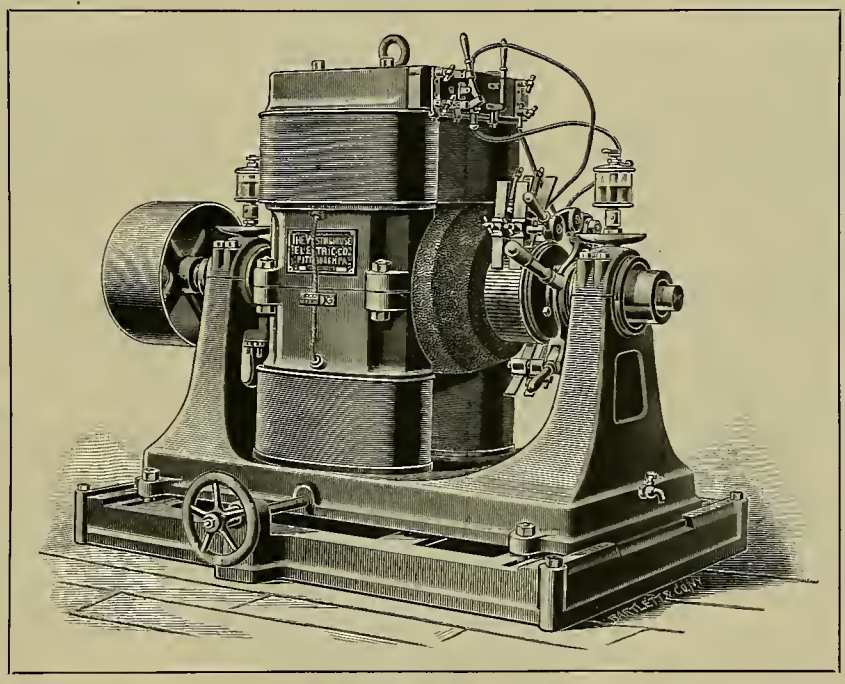

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This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

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2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross Relarences has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

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Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, JANUARY 4, 1890. No. 1.

Prof. Henry Hertz.

The accompanying portrait is that of Prof. Henry Hertz, whose remarkable experiments with waves of electric force have challenged the attention of the scientific world. A resume of his interesting experiments appeared in the WESTERN ELECTRICIAN during the months of November and December last. Dr. Hertz is at present professor of physics in the University of Bonn. He was born in 1857 at Hamburg. He was the son of Senator Hertz. He attended a gymnasium until 1875, and then studied engineering at Frankfort-on-the-Main, Berlin and Dresden. He studied physics in Munich and Berlin, and was graduated from the university in the latter city in 1880. For two years he was the assistant of Prof. Helmholtz, who first inspired Prof. Hertz to devote himself to the solution of electrical problems. In 1883 he was located at Kiel as "privat docent" for theoretical physics. Two years later he was called to a professorship of physics in the Technical High School in Karlsruhe, where he remained four years, resigning to take the place of Dr. Clausius in the University of Bonn. The importance of Dr. Hertz's work can scarcely be overestimated. He has devoted himself to the solution of electrical problems with a zeal which borders on enthusiasm. He is a young man, and there are many predictions that he will render to science services which will make his name still more famous.

To Stop the Issuance of Electric Railway Passes.

A curious suit has just been instituted in Omaha. T. J. Evans of the Omaha & Council Bluffs Bridge Railway company has brought an action against John T. Stewart, president of the company, C. H. Reynolds, superintendent, and the other directors. The suit is brought for an injunction restraining Stewart from issuing passes over the motor line, to restrain the directors from authorizing the issuing of passes, and to prevent Superintendent Reynolds from honoring them.

The petition for the injunction order shows that Evans is a director of the company, and hold 750 shares, or one-tenth of its stock. It alleges that John T. Stewart has issued so many passes to certain persons and parties, or to whole families, that the revenue of the company has been decreased $7,500 in 1889; and it alleges that the output of passes for 1890 promises to be much greater than that for 1889, and the loss will be correspondingly greater. All these passes, the petition goes on to say, do the company no good, but are for the special benefit of Stewart and the directors favoring them, and are issued without authority from the constitution and by-laws, or from a majority of the stockholders. The directors, according to Evans' allegation, are in collusion with Stewart and receive benefit from some of the passes which are issued.

Mr. Evans asserts that the company is one organized solely for the purpose of gain, and should attend strictly to business. The constitution and by-laws of the company do not give any authority to the president to issue passes except to employes, or in cases where such passes will benefit the whole company, and then only by order of the directors. But the other directors, having an understanding with Stewart, will order the issuance of passes as before, unless restrained.

Therefore Evans asks the court to grant a temporary injunction, restraining the defendants as above stated, till the case can be heard and it be determined whether the injunction shall be permanent.

Mr. Edison's Phonograph Speech at the Kansas City Convention.

The programme for the Kansas City convention of the National Electric Light association, Feb. 11th, 12th, 13th, 14th, has been announced. Mr. Edison will address the convention by phonograph. It is stated that President E. R. Weeks called upon Mr. Edison and insisted on the latter attending the convention and reading a paper. Mr. Edison informed the president of the association that he could not possibly comply. President Weeks insisted, and at last Mr. Edison said:

PROF. HENRY HERTZ.

"I tell you what I will do if it is satisfactory to you. I will talk to my phonograph and send it to Kansas City to lecture for me. It will make no gestures, but the tone will be perfect, and I will warrant that it can be heard all over the Opera House."

This agreement was satisfactory to President Weeks, as very few persons have ever heard Mr. Edison speak in public.

The paper which Prof. Elihu Thomson will read at the Kansas City convention of the National Electric Light association, will treat of "Safety Devices in Electrical Installations."

Electrical Execution Law Declared Constitutional.

The case of William Kemmler of Buffalo, who was convicted of murder and sentenced to be executed by electricity, has occupied considerable attention, as it was the first case to come under the new law in New York. It will be remembered that an appeal from the sentence was taken, and a hard fight made to save Kemmler's life. The ground on which the appeal was made was that the new law was unconstitutional, as the punishment was cruel and unusual. W. Bourke Cochran, the eminent New York attorney, became interested in Kemmler's case, and assumed the direction of his defence. On the hearing before the referee at New York, many well-known scientists were called, and there appeared a great diversity of opinion as to the death-dealing qualities of the electric current. Judge Day of Auburn, to whom the referee's report was made, refused to interfere, and an appeal was taken to the General Term. The argument was made October 18th, at Rochester, N. Y., and the case has since been under consideration. On Monday last the decision was handed down at Rochester. The following special dispatch to the WESTERN ELECTRICIAN from that city tells the story:

"In the General Term, Monday, Justices Barker, Dwight and Macomber handed down a decision affirming the order of County Judge Day of Auburn, dismissing the writ of habeas corpus in the case of William Kemmler, the Buffalo murderer. The opinion by Justice Dwight accompanied the decision. After briefly reciting the history of the case, the opinion describes the English Bill of Rights, its adoption into the constitution of the United States, and its bearing upon legislation. The question whether punishment by death under the electrical execution act would be cruel or unusual is then discussed, and the opinion holds that it must have been decided in the negative by the legislature. The opinion declares that the court is not competent to inquire whether the legislature, while intending to confirm the statute more closely to the constitution, has fallen through ignorance of the effect. In concluding, the opinion says: 'The court agrees with Judge Day that the burden of proof is not borne by relator. The evidence is clearly in favor of the conclusion that it is within the reach of electrical science to generate and apply to the convict a current of such known force as to certainly produce instantaneous and, therefore, painless death. It detracts nothing from the force of evidence in favor of this conclusion that we do not know the nature of electricity or how transmitted to destroy life; neither do we know the nature, gravitation or operative force in death by hanging. Experiments disclosed by evidence were confined to animals, but the frequency and publicity of death by accidental contact with electric wires during the last few years, especially in the last few months, have made the deadly power of electric currents shockingly familiar. In some cases the victim has escaped with life, and in some cases death has been accompanied with burning and contortions. In all such cases these effects have evidently been due to lack of force in current re-

ceived, or imperfect application. The general result of the demonstrations in the light of the scientific evidence in this case is, we think, to remove every reasonable doubt that the passage of a current of electricity of certain well-determined intensity through vital parts of the human body under chosen conditions of contact and resistance must result in instant death.'"

The result of the appeal will undoubtedly be a surprise to the electrical fraternity at large, as it was confidently expected that the law would be declared unconstitutional. An appeal will now be taken to New York Court of Appeals. The opposition to the enforcement of the death penalty by electricity is growing in New York as elsewhere, and it is believed the law will be repealed by the legislature.

Signaling Device for Elevators in the Auditorium.

The diagrams presented herewith illustrate a few of the details of an electric signaling apparatus which is being applied to several of the freight elevators in the Auditorium building, Chicago. In this system the attendant is notified that the elevator is wanted at a certain floor by the ringing of a bell and the lighting of an incandescent lamp at the particular floor. In order that the action of the apparatus may be illustrated, it may be assumed that the car is wanted at W, Fig. 1. To give the signal, a small knob near the door is pressed. This rings an electric gong located in the shaft, and at the same time lights a lamp at this floor. As no signal lamp above him is lighted, the attendant on hearing the bell, knows that the elevator is wanted at a floor below. As the lamps which are over the doors opening to the several floors can be seen by the attendant from a point at some little distance above, there is no trouble in stopping in the descent at the proper point. As will be seen from an inspection of Fig. 1, each

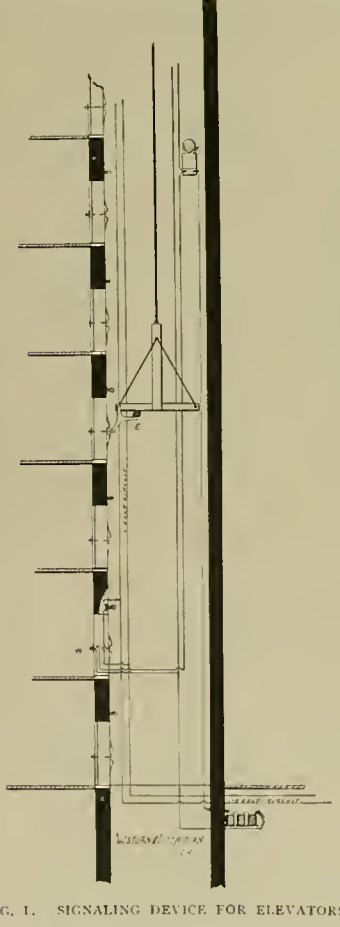


FIG. 1. SIGNALING DEVICE FOR ELEVATORS.

floor is provided with a push button and a lamp. These are connected at each floor, as shown at W. The details of the push button are represented in Fig. 2. A small battery of open circuit cells furnishes current for the bell. The lamps are supplied from the Edison system in the building. The practical operation of the system is as follows: The inward movement of the push button, shown more clearly in Fig. 2, serves to close the bell circuit and then throw a small quick action Bryant switch, S. The bell ceases to ring the moment the hand is removed from the button. The switch, however, remains closed, keeping the current on the lamp. The device which is represented diagrammatically at E now comes into play for the automatic extinguishment of the lights. This consists merely of a small roller or wheel which is attached to the car, and so arranged that the action of a stout spring causes it to bear out against the wall of the shaft. The descent of the elevator

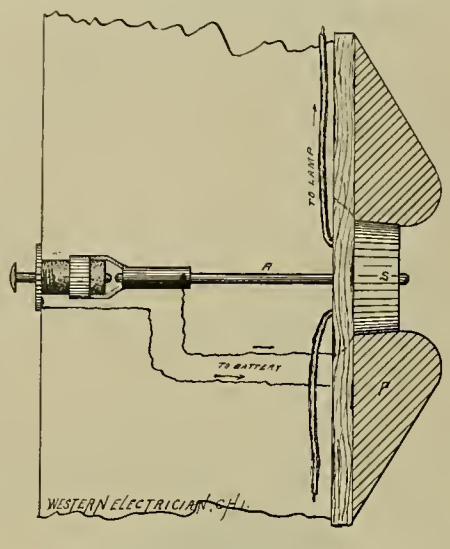


FIG. 2. SIGNALING DEVICE FOR ELEVATORS.

brings E into action. This wheel rolls over the beveled blocks, P, which are set, in the manner shown in Figs. 1 and 2, at the end of each switch shaft R. As the roller passes over the blocks, it meets the protruding end of the switch shaft, forces it back, and opens the switch. This action extinguishes the lamp. The apparatus was designed by C. G. Armstrong, manager of the electrical department of the New Haven Clock company, Chicago.

The New York Situation.

The gangs of linemen under the supervision of Commissioner Gilroy continued their work of cutting down poles and removing wires in New York city last week. The companies, it is stated, will institute actions to recover for damages done to their property. They are waiting until the work of destruction ceases so that they can put an estimate on their losses. W. H. Kelley of the East River company made this statement: "I can say that it has been definitely determined to bring suit for damages probably against Commissioner Gilroy and the city, too. This wanton destruction of safe wires is a species of hysteria and will cure itself. I believe that Mr. Gilroy is honest, but the Board of Electrical Control is imposing upon him. He has authority to remove dangerous wires only. The inspectors point out as dangerous wires all those which have been put up in violation of the unreasonable rules of the board. But the responsibility falls upon Commissioner Gilroy. The East River company will sue for something like $250,000."

The work has developed a goodly number of humorous incidents. So many of the men are entirely unused to the work that they frequently get into awkward scrapes. When a gang came to remove a pole at Carmine and Bleecker streets one of the men climbed part way up, and stepped off upon a shed, so that he might push the pole in such a way that it would fall into the street. The pole went down right enough, and with it went the workman's avenue of descent. There was no ladder handy and no way of entering any adjoining building except through a very small window, which was not made to open. A great crowd gathered and laughed heartlessly at the situation. After a time the residents of the adjoining building removed the window, sash and all, and he squeezed through.

A New York paper quotes a superintendent in one of the largest electric light works in the United States as saying: "For æsthetic reasons I think the wires ought to come down. They badly disfigure the city. But that is the only purpose that can be served. The general public is in only the very slightest danger from the overhead wires, if it exercises reasonable care over itself. The linemen are almost the only people who ever get hurt. And their calling will be just as dangerous with the wires underground as it is now. It will be more difficult to keep the wires in proper order after they are buried, and I prophesy that there will be just as much concern over them then as there is now. Storekeepers will be just as likely to lower their lamps and the public just as quick to blame the companies for resulting accidents as in the past. But the city will look better, I admit."

Death of Prof. Luigi Pacinotti.

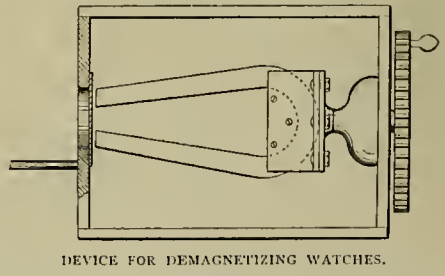
Prof. Luigi Pacinotti, the Italian scientist, died at Pisa recently, aged 87 years. His entire life had been devoted to scientific researches and his discoveries brought him into prominence early in life. From his youth he was much devoted to mathematics, and gave much attention to this subject. He pursued his studies at Pisa, and in 1831 was appointed to the chair of experimental physics in the university at that city. Ten years later the chair of experimental science was established at Pisa, and Pacinotti, who had done much to promote scientific researches and experimental work, was promoted to the new position. The college of Italian scientists in 1840 had highly praised his work, and Pacinotti was thus brought into greater prominence in the scientific world, but it was not until 1864 that he announced to the world his best known work. This was the Pacinotti ring. The question of generating electric currents was occupying the attention of scientists at this time, especially that of procuring continuous currents with little fluctuation in strength. Pacinotti's discovery, the merits of which are now appreciated, was not recognized at the time, and in spite of its value, the model of his machine lay forgotten among the collection of instruments at the University of Pisa, until its fundamental points had been rediscovered, or at least, put into practice by others.

He devoted much time to the development of the electric motor, and was one of the earliest inventors in this field. Numerous other machines of great value were discovered by him, and his researches and experimental work were of great scientific value.

Demagnetizing Watches.

The accompanying cut illustrates a simple device for demagnetizing watches. The machine consists of an ordinary horseshoe magnet, mounted as shown, on a short horizontal shaft, and arranged to be revolved rapidly by means of gearing. The operation of the device is as follows:

The works of the watch to be demagnetized



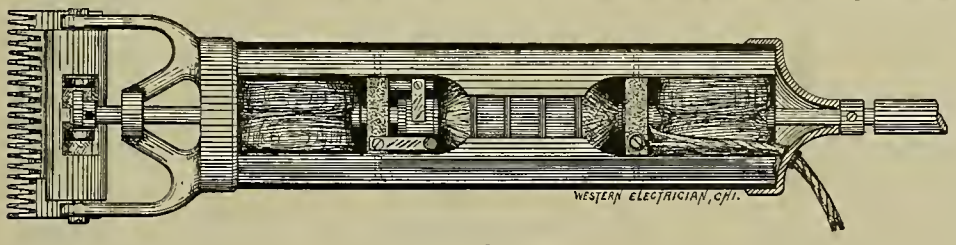
DEVICE FOR DEMAGNETIZING WATCHES.

are held in the opening shown at the left in the cut, within the field of the magnet, the rod being employed as a support and a guide for the hand. The magnet is then rapidly revolved by means of the gearing and the watch-works are revolved by the hand and slowly drawn away from the poles of the magnet. The magnetized works are thus subjected to a rapid and constant change of polarity. As the works are slowly withdrawn from the magnet, each change decreases in intensity. This operation is repeated until the last change is a minimum one, and the steel or magnetized parts of the watch are reduced to their normal condition, or nearly so.

The plate in front of the poles serves simply as a guard to prevent the watch from being accidentally brought into contact with magnet. The device is the invention of F. J. Wilton, Boston.

An Electric Clipper.

The accompanying cut illustrates a most ingenious combination of an electric motor with a hair clipper. The little machine is designed to be operated by current from a 110-volt constant potential circuit, and is run with a 50-volt lamp in series. The cut shows the internal arrangement of the handle, which is nothing more or less than the motor itself inclosed in a cylindrical rubber case. The shaft which passes through the center has fixed upon it the armature and



AN ELECTRIC CLIPPER.

extends as shown at both ends. The end at the clipper carries a small eccentric. This plays between two small pieces which are set into and form part of the movable blade of the clipper. By this arrangement the revolution of the armature gives the blade a rapid reciprocating motion. The most ingenious feature of the machine is the manner in which the essential parts, *i. e.*, the armature and field magnets, have been disposed so as to economize space. The field magnets are wound so that consequent poles will be produced at the armature. It will be noticed that the pole-pieces extend the length of, and form the body of the handle. The motor is shunt wound. A small clip or spring, shown in the cut by the side of the upper brush, constitutes the starting switch. A little hard rubber plug on the end of the clip extends out through a hole in the casing. A slight pressure of the operator's finger upon this little plug or button serves first to throw the field magnets into circuit and then turn the current into the armature. The flexible cord shown to the right is attached to a plug which fits into an incandescent lamp socket. It may be mentioned that this form of motor is also applicable to quite a number of small tools which may be most conveniently driven by electricity. The end of the armature shaft, shown to the right, may be utilized in a variety of ways; for instance, where the clipping machine is in service a revolving brush may be fitted on this end. The convenience of such an arrangement is evident. The machine is the invention of Chas. E. Jones, Elgin, Ill. The details of the invention were worked out by Foree Bain, Chicago.

The New York Grand Jury's Findings.

In New York, December 27, the grand jury found an indictment against Charles W. Pierce, superintendent of the Brush Electric Light company, charging him with manslaughter. The indictment accuses Mr. Pierce of being instrumental in causing the death of Henry Harris, a clerk in a store on Eighth avenue, November 30. Harris and another clerk were carrying a showcase into the store. The show case touched a low hanging arc lamp, and Harris was instantly killed. Mr. Pierce furnished bonds in the sum of $2,500.

The foreman of the grand jury handed to the court the appended presentment which contained the result of its deliberation concerning the fatalities from electric wires:

The grand jury has devoted a great deal of time to the investigation of the various systems of electrical generators, and the distribution and transmission of electrical currents for light and power purposes by means of aerial and underground wires through the public streets of the city now in operation, for the purpose of ascertaining whether the systems are operated with a due and proper regard for the lives and safety of the public, and particularly under what circumstances such systems can be safely operated.

For this purpose the grand jury has considered a great mass of testimony given by witnesses to casualties occurring from electric currents, and by scientific men. There appears to be a great diversity of opinion among those best qualified to testify on every branch of the inquiry and as to every detail connected with the subject. It has been difficult for the grand jury to come to a satisfactory conclusion. The grand jury has listened to a great deal of testimony of so-called experts in the appliance of electricity for the production of light, many of whom are retained by or interested in the various electric light companies. There was a diversity of opinion among them as to the danger to life and property, and notwithstanding this, loss of life and the destruction of valuable property continues, and if permitted to go on, life and property will be daily menaced—a condition of affairs which no adequate plan has yet been devised to prevent.

It is manifest that legislative action should be invoked at once to provide a means of preventing further casualties by electric currents. It was recently shown to the Supreme court of the state that wires for the transmission of electricity have been permitted to become in a condition dangerous to human life, so that passers-by, in short, were liable to be struck dead, and therefore that the corporations responsible for this condition of things were conducting a business by means of an apparatus and a force which, unless properly controlled, subjected the citizens of this city to the danger of death. Therefore the court held the facts constituted a public nuisance, and directed that an injunction previously obtained, restraining the authorities from interfering with these wires, should be vacated and set aside, on the ground that not only the public authorities but any citizen would be justified in abolishing the nuisance. Of this decision the grand jury heartily approve. Inasmuch as the authorities are now engaged in removing the dangerous wires and apparatus condemned by the court, the grand jury have not deemed it necessary to take action in reference thereto; the result to be accomplished by a criminal indictment for a nuisance—to-wit, the abatement of the nuisance—having already been brought about by the decision of the Supreme court.

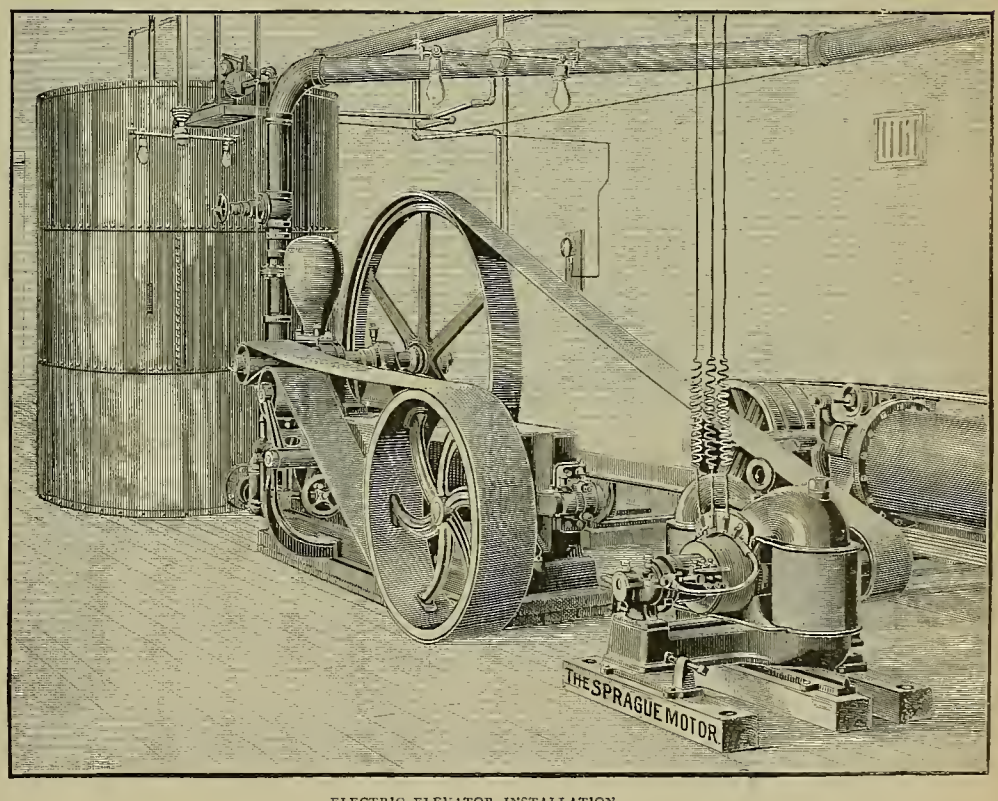
The grand jury is convinced that the business of the generation and distribution of electrical currents is one which should be investigated by the legislature for the purpose of ascertaining the character of legislative enactment required to provide a means for carrying on the same without danger to the public.

We therefore recommend that the legislature shall without delay appoint a committee of its members to inquire into the subject and report upon a plan of legislation designed to prevent further danger to the public from electrical apparatus.

Electric Elevator Installation

A view is herewith presented of a hydraulic elevator installation recently made at the building of the United Security Trust & Safe Deposit company of Philadelphia by the Otis Elevator company of Yonkers, N. Y., and Chadbourne, Hazleton & Co. of Philadelphia, agents in Pennsylvania for the Sprague Electric Railway & Motor company. One of the first things which strikes an observer is the minimum of space required for every part of the installation. The pump was manufactured by the Otis Elevator company specially for the plant, and the arrangement for reduction of speed between the armature shaft and pump is made in the compact manner shown in the illustration. The motor operates the pump against a pressure in the tank; there is no overflow, and when the maximum pressure is reached, the motor runs empty, automatically cutting down the amount of electric current taken from the line, so that only sufficient current is used to supply the energy to keep the motor in revolution.

Before the installation of the electric motor at this place, a gas engine was used to supply the necessary power, but gas never proved satisfactory in this capacity, and the Sprague motor was substituted. The motor is giving perfect satisfaction, and the plant is one of the finest running elevators in Philadelphia.



ELECTRIC ELEVATOR INSTALLATION.

Electric Lighting in St. Louis.

It has already been stated that the Municipal Electric Light company's station in St. Louis was not completed. It had been hoped that it would be finished by New Year's day, but numerous obstacles were encountered which prevented the operation of the plant on January 1. This was the day set by the contract for the commencement of the city lighting. It will be necessary to use gas until the plant is in shape. The gas bill will be paid by the electric light company. Last week the gas company and the representatives of the electric light company met to agree upon terms but as the former saw that the next few weeks would be the last period in which it would light the city, it was not inclined to name a low price.

It is now stated that the Municipal company's plant will be completed sooner than has been generally thought. An extension of the contract until April 1 has been asked for, but one of the managers asserts that the plant will be in readiness before that time. He said: "The Municipal Electric Light company, to which the contract of Mr. Sutter was transferred, will probably be in service by February 1. The supposition has always been that the company would lose money on the city contracts. The new management has had the matter carefully estimated by the most expert electricians, and they are now confident that the city contracts will yield a profit almost equal to the interest on the company's bonded indebtedness. The new directors have held several meetings, and have been so encouraged by the condition of affairs

that they have adopted a definite policy, after first considering making temporary arrangements. The first of these was to utilize the United Electric company's plant, but it was found that it would require different lamps and different circuits, necessitating the stringing of new wires, and the erection of many new poles. In addition, the use of the United would seriously strain its commercial business. Under these circumstances it was decided to go ahead as rapidly as possible with the permanent work. The machinery, it is thought, will all be in place fifteen days after the first day of January. To start then would probably show imperfections and necessitate a stoppage of fifteen to thirty days. To avoid this about fifteen days will be consumed in testing and perfecting the entire plant. In the meantime the light will be turned on district by district, as the company feels safe in doing it without possibility of having to suspend."

The United Electric Light & Power company, which has the contract for illuminating the public alleys in St. Louis had a large number of the lights in the western and northwestern parts of the city burning for awhile last week, by way of testing the circuit and lights.

It is stated that the Norwalk Light & Power company of Norwalk, O., will build an electric railway in that city.

Fuel Oil Burner.

The accompanying cuts illustrate a type of petroleum burner and setting for it, which are in use at a number of Chicago establishments. For the benefit of electric light men who may be considering the introduction of a fuel oil system, a few of the more important details are presented.

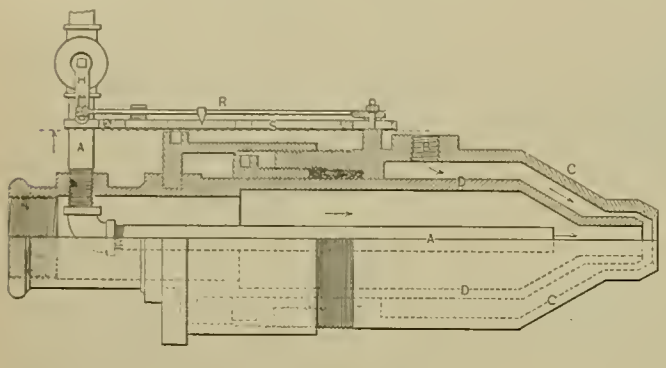


FIG. 1. REID FUEL OIL BURNER.

From Fig. 1 a good idea can be formed of the construction of the Reid apparatus. It is of the injector type, steam being used as the spraying agent. Its novelty is found more particularly in the mechanism by which the admission of oil and steam into the combustion chamber is regulated. The regulation is effected by having a movable nozzle arranged as shown. This controls the steam supply and is so connected that when it is operated either to increase or diminish the flow of steam, the oil cock also will be opened or closed. The nozzle is designated by the letters *CC*; *B* is the steam port. The nozzle has the usual funnel-shaped mouth, which fits over the end of the interior nozzle, *D D*. It will be readily understood that when the exterior portion *C* is moved the opening between its mouth and that of the nozzle *D* will vary, and thus regulate the volume of issuing steam. The rear end of the nozzle *C* is threaded and furnished with suitable packing and a gland to insure steam tightness, while the fixed nozzle *D* is provided with an internally threaded flanged collar set in a circumferential groove, as shown. This collar has a wrench socket and is adapted to engage the thread of the nozzle *C*, and when turned, moves the latter back and forth as desired. The oil pipe *A* enters the side of the nozzle *D*, and extends parallel with it on the interior. It is provided also with a rack, regulated by the lever *H*. Rigidly fixed to the reciprocating nozzle *C* is a lug, which carries a pin working the connecting rod R. The latter carries an index hand, and its left hand end is attached to the oil cock lever *H*, an anti-friction roller being arranged to work in a slot in this lever.

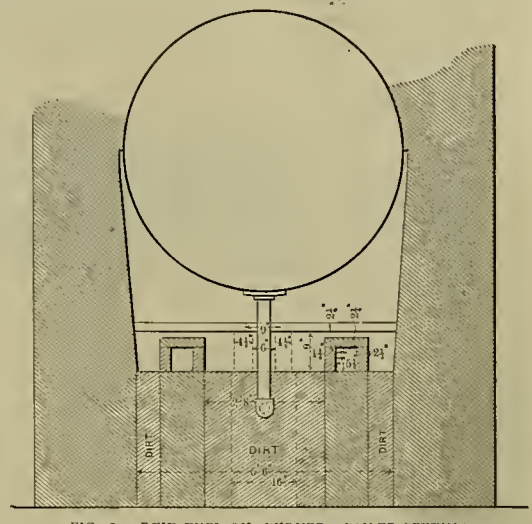


FIG. 3. REID FUEL OIL BURNER—BOILER SETTING.

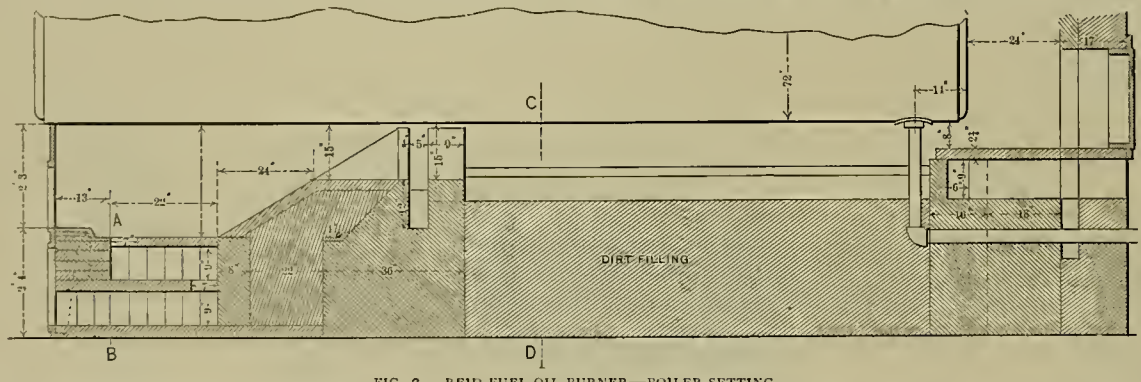


FIG. 2. REID FUEL OIL BURNER—BOILER SETTING.

It will thus be seen that the oil cock and steam regulator are so connected as to be compelled to work in unison. The graduated strip *S* passes around the oil pipe *A*, and its opposite end is slotted so as to permit free motion of the pin of the connecting rod R. The scale rod *S* has a guide, as shown, through which the rod *R* passes. After the parts have been put together and tested, the rod *S* is suitably graduated to indicate the quantity of oil passing into the burner for a given time. The burners are made in four sizes.

In Figs. 2, 3 and 4 is shown the form of boiler setting which is recommended for use in connection with the burners. It will be noticed that

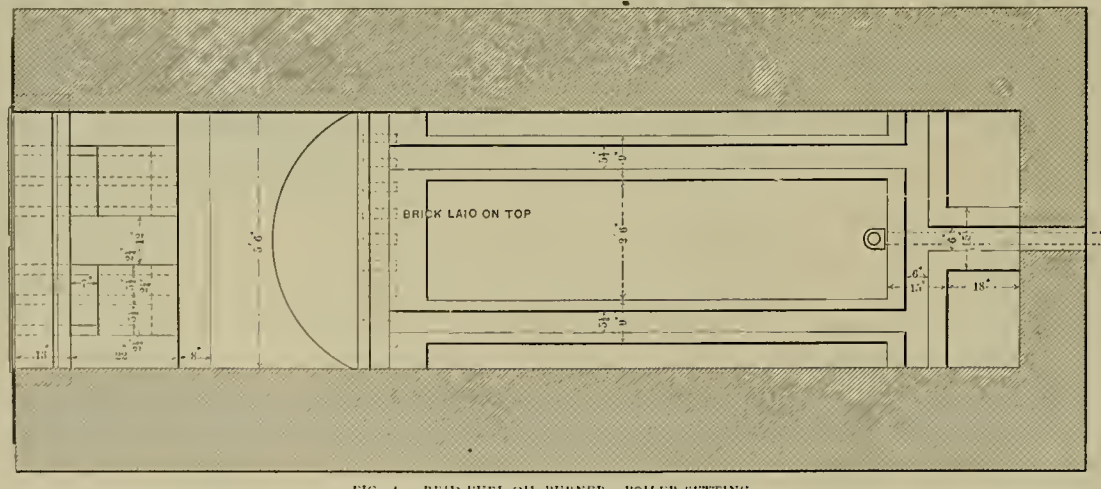


FIG. 4. REID FUEL OIL BURNER—BOILER SETTING.

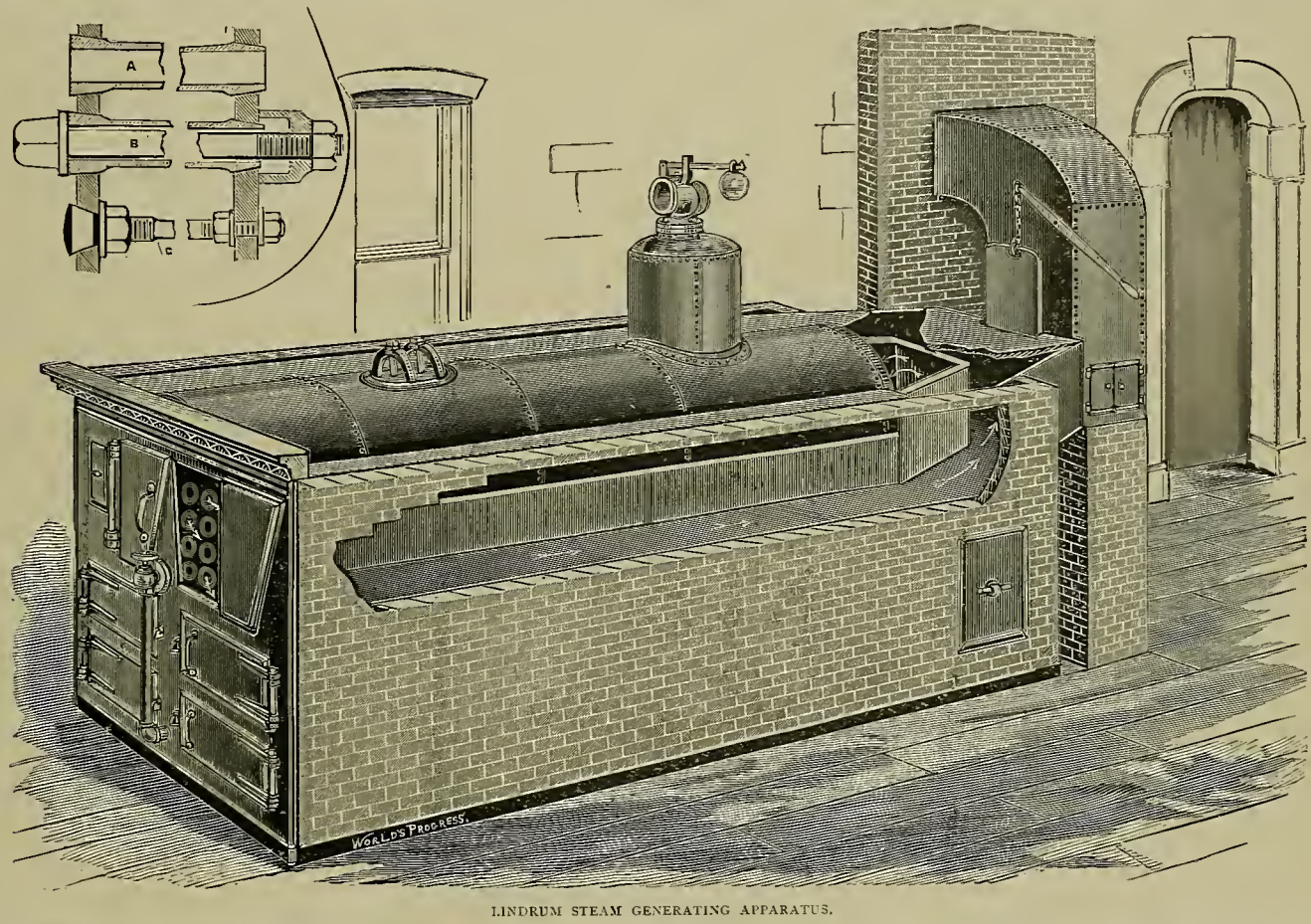
the grate bars, firing doors and ash pit doors have been removed. A wall is built up from the floor to a level with the bearing bar, about eight inches thick and thirty five inches distant from the front facing. From this eight inch wall an incline is made to meet the top of the old bridge wall, the space between the walls being filled with sand. The angle of incline between these walls should be as near forty-five degrees as possible. Should it occur that the distance between the walls is too great to permit of this, it should be accomplished by making the angle of forty-five degrees from the front wall, thence going back in a straight line to the top of the old bridge wall. This wall and incline should be faced with the best fire-brick, and well cemented. An eight inch wall should be erected in the rear of and against the old bridge wall forming a hollow space of five inches as shown.

This is covered with brick laid edgewise, four inches apart. The distance between the upper sides of these bricks and the bottom of the boiler should be about eight inches. Two 6-inch air flues are then constructed, beginning from an opening at the back wall and extending to and connecting with the hollow bridge wall, Fig. 3. They are run parallel to the side walls, and at a distance of from fifteen to eighteen inches from them. They may be made of fire-brick or tile. Two supporting walls should be built for these flues. Two air flues should also be built in the ash-pit, as shown in Fig. 2, 7-inch openings being left at the back end of the lower and the front end of the upper section. Fire-brick standing on end is used in these. The whole should be thoroughly cemented. The ash-pit should then be filled with ashes to a level with the lower section. The firing place and ash-door openings should then be closed entirely. Dampers may be placed in the air flues to assist in regulating the supply. In using ashes care should be taken to have them as free from coal dust as possible. When a burner is set under a boiler it should be connected with both the steam and oil line by a swinging joint, so that the direction of the flame can be easily changed upward or downward, or to either side, as may be required to secure a uniform heat. The front end of the burner should be about six inches inside of the fire opening, and after being connected up, this opening around the burner should be bricked up tightly so as to prevent the cold air from entering the furnace.

Among the companies using the Reid system may be mentioned the Brush Electric Company, Cleveland, Badger Electric Light Company, Racine, Wis., the Illinois Steel company, and a large number of other manufacturers. The burner is handled by E. E. Billow & Co., Chicago.

Lindrum Steam Generating Apparatus.

The accompanying cut illustrates the principal features of a boiler setting, recently patented by F. Lindrum, Chicago. In the usual form of boiler setting, the heat going back beneath the boiler returns to the front end through the flues, and thence goes directly up the stack or chimney. In the Lindrum setting the heat is caused to pass along side flues back to the chimney at the rear of the boiler. The boiler is almost covered, and the heat passages are closed at the top, the chamber at the rear end being isolated from the side flue passages. The flame passes, as usual, beneath the boiler, thence up and into the flues to the front end, where space is provided. The heat then pours out to each side into the passages, thence meeting in the chimney, as indicated by the arrows. The back fire chamber is accessible through a door in the side of the masonry. An interesting feature of the apparatus is the boiler cleaner, which is so constructed that it gathers the sedimentary matter and disposes of it so that it can be blown out. Inside the boiler is a large cylindrical tube with closed ends, extending nearly the length of the boiler, and supported a little above the bottom of the latter. At short intervals along the top of the cylinder are vertical tubes with funnel-shaped openings reaching up to just beneath the normal water line. The water in boiling causes the foreign matter to be thrown to the surface and gather along the central line, which is comparatively quiescent. These particles in sinking again are caught by the funnel tubes, and pass down into the collecting cylinder. A large aperture is formed in the front head of the boiler, from which a projecting neck or tube extends to a point in front of the boiler setting. There it is closed by a plate securely bolted to the annular flange at the extremity of the neck. A blow-off pipe from the front head of the collector near its bottom extends through this neck and the plate, outside of which it is provided with a valve, by means of which the discharge from the collector may be regulated as desired. This pipe is threaded near its outer end, and is provided with check nuts and soft washers on each side of the plate to form a secure and tight joint. Another feature is the method of setting tubes in the boiler in such manner as to allow the introduction or removal of any tube without disturbing any other portion, or injuring the tubes or apertures. The old method of clinching the ends of the tubes renders their removal impossible without injury. This invention, it is claimed, facilitates the operation while avoiding the common difficulties. In the small sectional illustration, A represents a tube having taper ends which respectively fit corresponding apertures in the tube plates. B represents the manner of tightening the tubes in place. A rod, threaded at one end, is passed through the tube, the threaded portion passing through a cup bearing that is seated around the tube aperture. The nut draws the tube tightly in place, the large washer at the other end forming a bearing for the headed end of the rod. The tube sheets are braced as shown at C. For the cut and description we are indebted to *World's Progress*.



LINDRUM STEAM GENERATING APPARATUS.

The Connecticut Electric Light Association.

A meeting of representatives of central station companies doing business in the state of Connecticut was held at New Haven, December 23d. Eleven companies were represented in person, and a number of others by letter. A majority of the companies of the state having reported, and more than a majority of the capitalization in the state being represented in person, it was resolved to effect an organization at once. A constitution was adopted, and the following officers were elected:

President, James English; first vice-president, J. A. Manley; second vice-president, J. A. Stone; treasurer, John C. English; secretary, A. M. Young. Executive committee—James English, New Haven; J. A. Hoadley, Meriden; J. A. Stowe, Middletown; John C. English, Bridgeport; A. M. Young, Waterbury; L. S. Beardsley, Naugatuck; F. F. Fuserich, Torrington.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 125 TEMPLE COURT, NEW YORK.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only electrical journal published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

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"LA GRIPPE," which is so disagreeably affecting so many persons in all parts of this country and Europe, is the result of a disturbance of atmospheric conditions by the generation of electricity, according to a New Yorker, who thinks he is quite learned. This erudite individual says: "You will observe that the influenza is most prevalent and malignant in Europe in places remote from the seashore, where the air from the ocean partially neutralizes the baneful effects of artificial electricity. London, in fact, Great Britain, is as yet but little troubled. Artificial electricity is literally changing the very constitution of our atmosphere." What is artificial electricity, by the way?

THE General Term of the Supreme court of the State of New York has sustained the position of Judge Day, and pronounced the law providing for electrical executions constitutional. A brief summary of the proceedings and decision in this celebrated case is given elsewhere. The decision of the court will surprise the electrical fraternity. Judge Dwight in his opinion refers to the recent deaths in New York in a manner that would indicate that he and his associates had been somewhat influenced by these calamities. The fight over the constitutionality of the case will, of course, be continued. An appeal will now be taken to the New York State Court of Appeals. The prospect for securing a reversal of the decision is not particularly bright, inasmuch as it is a well-known fact that the Court of Appeals rarely overrules Judge Dwight as he is recognized as one of the ablest jurists in New York State. It is believed that there is a growing sentiment against electrical executions, and unquestionably the legislature will be asked to repeal the act. Certain it is, if the wishes of the electrical fraternity are consulted, the obnoxious law will be erased from the statute books.

THE London correspondents of daily newspapers have recently kept us well informed of the progress of electric lighting in London. Several correspondents have cabled the fact that the accidents in New York had had a depressing effect on the English electric light men, but the latest report contained in the following cablegram presents a different aspect: "The Board of Trade has received from England and Wales 170 applications for provisional orders relating to electric lighting. Of these twenty-three relate solely to London, the orders covering practically all parts of the city three times over. The metropolis is divided into sections, especially arranged with reference to electric lighting, so that no company or, indeed, small syndicate of companies, shall have a monopoly. The city proper will be supplied by three companies, and other sections of the metropolis will fare in a similar manner. In laying sub-wires recently in the Strand the workmen tore up the sidewalk instead of the street. The wires were laid in separate conduits, only about three-quarters of a foot below the surface of the concrete sidewalk. Now that electric lighting has been made cheaper, and improved facilities have been granted by Parliament, the project is being carried forward with a boom all over the kingdom. The cheapness of London gas, as compared with the New York gas charges, is still an important factor in the fight against electricity. London gas costs sixty-two cents a thousand feet, and electricity cannot yet hope to compete with that price."

A NEW JERSEY inventor thinks he has hit upon a method of establishing peace permanently upon the earth by means of electricity. He does not propose to remodel human nature, but expects to make warfare so deadly that it will be sheer madness for one nation to attack another. According to his plan warfare would result in the substantial extermination of all who ventured to engage in it. The inventor describes his idea thus: "In a word, my scheme is to produce artificial lightning. Thus far the experiments have been confined within narrow limits, but with the use of a small dynamo attached to my invention a slight shock can be produced, effective enough to kill the flies in a 20x20 room. I claim, with the use of powerful dynamos, under my plan, a flash of lightning can be directed against an army a mile or more away and without injury to the party operating the gun, scattering death and consternation among the troops. With powerful dynamos thousands of soldiers can be killed at a flash, and a number of flashes are enough to destroy an army. It can be used at any time except on rainy or damp days. If the effect of giving this discovery would be, as I hope, to put an end to war, I should feel repaid, but I dread to think of electricity being used in war under my plan. The consequences would be enormous. It means nothing less than extermination to the opposing army. Before going any further with it I would ask your opinion as to the effect upon war of an instrument such as I have hinted at. Would it retard or facilitate war?"

POSTMASTER-GENERAL WANAMAKER'S project that he be authorized by Congress to organize a limited postal telegraph service, will be considered by the committee on postoffices and post roads. Congressman Hopkins, who is a member of that committee, was asked when he was in Chicago a few days ago, what he thought of the plan. He said: "Mr. Wanamaker earnestly desires that the government try the telegraph business, and the friends of the postal telegraph scheme will make a strong fight. So far as I am concerned I doubt the advisability of increasing the number of public employes to the extent that a postal telegraph system would necessitate. It might, however, be a practical plan to make some contract with the telegraph companies so that the postal department could have messages transmitted at a low rate, and deliver the messages by carrier. If such an arrangement could be made with the telegraph companies it would certainly be better than creating several thousand new positions in the civil service."

The limited postal telegraph scheme does not arouse any great amount of enthusiasm. It is too mild a measure for those who believe in governmental telegraph and it does not attract those who are opposed to that idea. A contemporary says: "It is hard to see what practical end it would serve. If there is a complaint against the existing telegraph service, the complaint must be that the charges are too high or the delivery is too slow, or, possibly, that some small places cannot be reached. The postal telegraph plan under consideration is restricted to free-delivery places and consequently applies only to towns already supplied with ample telegraphic facilities. As to prices, it is not to be expected that existing lines will allow the government to become their lessee to underbid them. If the government is allowed to send messages by its leased lines at a low rate, it will be because the slower delivery provided for will more than counterbalance in the mind of the public the decreased rates. The sender of a telegraph message wants it delivered at once. If he wanted it delivered as mail he would write and not telegraph."

THE most sensible article on the electric light question in New York, which has thus far been published in a New York paper, appeared in the New York *Sun* last week. So much common sense is shown in the article in question that a considerable part of it is well worth reproducing. Speaking of the discontinuance of the electric light service, it says: "The interruption of the electric lighting in so large a part of the town has served as a practical demonstration that the new method of illumination has become a necessity to the community. When the people had the electric lights in the streets they did not appreciate their vast superiority to the old gas lamps, which they had gradually replaced. But now that they are gone and we are forced to rely again on gas alone, everybody discovers how much was gained when modern invention utilized electricity for illuminating purposes. Undoubtedly the precise manner in which the electricity was made available was bad and dangerous." The dangers arising from poor construction are referred to, and the necessity of making the system of lighting absolutely safe is emphasized. The article continues: "But the interruption of this now necessary illumination will be temporary only. We must have the electric light. We cannot get along without it. It has become essential to business, which has been regulated with reference to it, and civilization in a great town would suffer a set-back were we deprived of it. The only thing to do is to reduce to more scientific order the careless and experimental methods of its first introduction. There is no doubt that electric lighting can be made safe, so far at least as ordinary contingencies go, and that its vast superiority to every other for public and very many private purposes justifies any cost which such safety will render necessary. It is a problem for expert electricians to solve, and which they are capable of solving. A private individual would have no doubt as to where to go to get the matter settled, and the authorities have no reason for hesitation as to their manner of procedure. The treatment of electricity has become one of the recognized professions, and though so much is yet to be learned as to the agent, enough is already known to make entirely possible a sufficient remedy of the great evils due to the make-shift arrangements for the original introduction of the electric light.

"The period of deprivation, therefore, will be short, and when the light is again made available for safe use in all parts of the town the demand for it will be greater than before, and the cost of the improvements will be recompensed. The companies can afford to incur the additional expense, now that it has been practically demonstrated that they provide the community with what is indispensable to modern life."

Brush Lamp Patent Sustained.

Judge Gresham, in the United States Circuit court at Indianapolis last week, handed down a decision in which he sustained the patent of Charles F. Brush, for an improvement in a double carbon arc lamp. The suit was instituted by the Brush Electric company against the Fort Wayne Electric Light company and others. The full text of the decision follows:

The Brush Electric company *vs.* The Fort Wayne Electric Light company, et al.

This suit is brought for an alleged infringement of Letters Patent No. 219,208, granted to Charles F. Brush, September 2, 1879, for improvement in double carbon electric lamps of the arc type. Brush assigned the patent to complainant before suit was brought.

When two ordinary, pointed, carbon sticks are in contact in an electric current the circuit is closed, and the current freely passes through the carbons without the production of any appreciable amount of heat or light at the point of contact. If, however, while the electric current is passing through them, the carbons are slightly separated, the current will continue to flow in crossing or leaping the small space between the separated carbon points and intense heat and light will be produced. This is known as the electric arc lamp, and the one generally used for illuminating large buildings and halls, and for lighting streets. The incandescent electric light is produced by causing a current of electricity to pass through a filament in a glass bulb, from which the air has been exhausted. In its passage the current encounters great resistance, and as a consequence it is heated to a degree producing a bright, white light throughout its entire length. This light is well adapted to use indoors.

As early as 1810 Sir Humphrey Davy with a battery of 2,000 cells succeeded in producing an arc light between two horizontal charcoal pencils, insulated, except a small portion at their ends, but owing to the rapid combustion of the soft charcoal points, and the great cost of the battery and the short duration of the light, it was of no practical or commercial value. But little progress was made in the improvement of this arc light or lamp until 1844, when Foucault substituted pencils made of a hard gas carbon for the charcoal pencils of Davy, and thereby for the first time produced a persistent but short-lived electric arc light. By a clock-work mechanism Foucault fed the carbon pencils toward each other so as to imperfectly regulate their burning away and maintain the arc. The voltaic battery did not generate electricity on a sufficiently large scale, the light was expensive, and it did not go into general use.

Later the dynamo-electric machine was developed, in which a powerful current of electricity was produced by revolving coils of wire in a field of magnetic force furnished by powerful permanent magnets, after which the arc electric light was successfully used in lighthouses in England, and later (1867) in France. But up to this time no means had been devised for producing an adequate current of electricity for illumination at a practicable cost, and it was not until the invention of the Gramme dynamo electric machine, in 1872, that electricity was produced in a manner and of sufficient strength to render electric lighting practical and useful. This machine was afterward improved in details of construction. In this state of the art, Brush entered the field of invention, and on May 7, 1878, obtained Patent No. 203,412 for his arc lamp, which was superior to any lamp that had preceded it. This lamp, however, was not capable of burning continuously more than eight or ten hours, and when used for all-night lighting it was necessary to extinguish the light and renew the carbons; and in order to obviate this defect Brush invented the lamp in suit. The invention and the means by which it is carried out are thus described in this specification:

"My invention relates to electric lamps or light regulators, and it consists, first, in a lamp having two or more sets of carbons adapted, by any suitable means, to burn successively—that is, one set after another; second, in a lamp having two or more sets of carbons, each set adapted to move independently in burning and feeding; third, in a lamp having two or more sets of carbons adapted each to have independent movements, and each operated and influenced by the same electric current; fourth, in a lamp having two or more sets of carbons, said carbons, by any suitable means, being adapted to be separated dissimultaneously, whereby the voltaic arc between but a single set of carbons is produced; fifth, in the combination, with one of the carbons or carbon holders, of a lamp employing two or more sets of carbons, as above mentioned, of a suitable collar, tube or extended support, within or upon which the the carbon or carbon holder to which it is applied shall rest and be supported.

'I desire to state at the outstart that my invention is not limited in its application to any specific form of lamp. It may be used in any form of voltaic arc light regulator, and would need but a mere modification in mechanical form to be adaptable to an indefinite variety of the present forms of electric lamps.

"My invention comprehends broadly any lamp or light regulator where more than one set of carbons are employed wherein—say in a lamp having two sets of carbons—one set of carbons will separate before the other. For the purpose merely of showing and explaining the principles of operation and use of my invention, I shall describe it in the form shown in the drawings as applied to an electric lamp of the general type shown in the United States Letters Patent No. 203,411, granted to me May 7, 1879, reissued May 20, 1879, and numbered 8,718. The leading feature of this type of regulator is that the carbon holder has a rod or tube which slides through or past a friction clutch, which clutch is operated upon to grasp and move said carbon rod or holder, and thus to separate the carbons and produce the voltaic-arc light; and I shall refer to such a lamp in my following description:

"A represents one set of carbons; A' another set, each carbon having an independent holder BB'. The carbon holders BB' may either be in the form of a rod or tube, and each of them is made to pass through a clamping and lifting device CC', respectively. These clamps and lifters CC' are shown in the present instance in the shape of rings surrounding their respective carbon holders BB'. This form, while I have found it for general purposes the best, is not necessarily the only form of clamp that may be used in carrying out my present invention. Each ring clamp CC' is adapted to be lifted from a single point, thus tilting it and causing it to grasp and lift its inclosed carbon holder. This tilting and lifting movement is imparted to the clamps CC' by any suitable lifter, D, and this lifter may have its movement imparted either by magnetic attraction due to the current operating the lamp, or by the expansive action of heat upon any suitable apparatus connected with the lamp, said heat generated by the electric current operating the lamp.

"I do not in any degree limit myself to any specific method or mechanism for lifting, moving or separating the carbon points or their holders, so long as the peculiar functions and results, hereinafter to be specified, shall be accomplished. The lifter D' in the present instance is so formed that when it is raised it shall not operate upon the clamps CC' simultaneously, but shall lift, first, one and then the other (preferably the clamp C first and C' second, for reasons which shall hereinafter appear). This function or dissimultaneous action upon the carbons or their holders, whereby one set of carbons shall be separated in advance of the other, constitutes the principal and most important feature of my present invention. In the lamp shown in the drawings the lifter D is actuated and controlled through the agency of magnetic attraction due to the influence of the current operating the lamp, and this is accomplished as follows: One, two or more spools or hollow helices, E, of insulated wire are placed in the circuit, within whose cavities freely move cores E'. The electric current passing through the helices, E operate to strongly draw up within their cavities their respective cores E', in the same manner as specified in my former patent, above referred to. The cores E' are rigidly attached to a common bar, E^2, and the upward and downward movement of this bar, due to the varying attraction of the helices E, is imparted by a suitable link and lever connection, E^3 E^4, to the lifter D. By this connection the lifter will have an up and down movement in exact concert with the cores E'; and it is apparent that this connection between magnet and lifter may be indefinitely varied without any departure from my invention; and, therefore, while preferring for many purposes the construction just specified, I do not propose to limit myself to its use.

"The lifter D may be so constructed and applied as to separate the carbons A and A' successively or dissimultaneously by being so balanced that any difference, however slight, between the weights of the carbons AA', or their holders BB', shall result in one being lifted and separated before the other.

"In order properly to balance the attractive force of the magnets, a coil-spring F, or its equivalent, may be employed, substantially as shown; and to insure a steady motion to the magnets and to the carbon points, AA', a dash-pot G, or its equivalent, should be employed, as this prevents any too sudden, abrupt or excessive movement of parts.

"HH' are metallic cables through which the current is conducted from above the clamps CC' to the carbons AA'. By this provision is not only insured a good connection between the upper carbon points and the mechanism above it, but another important advantage is obtained, and that is the prevention of sparks due to any interruption of the current between the carbon holder BB' and its clamp or bearings. This spark, if occurring too frequently, is liable to burn and roughen the rods BB' or their bearings or clamps, and thereby render their operation uncertain, because it is important that a free movement to any degree, however minute, may be allowed the carbon holder. These cables HH', while operating as just specified, are sufficiently flexible and yielding not to interfere with any movement of their respective carbons or carbon holders.

"The operation of my device, as thus far specified, is as follows: When the current is not passing through the lamp, the positive and negative carbons of each set AA^1 are in actual contact. When, now, a current is passed through the lamp, the magnetic attractions of the helices E will operate to raise the lifter D. This lifter, operating upon the clamps C and C^1 tilts them and causes them to clamp and lift the carbon holders BB^1, and thus separate the carbons and produce the voltaic arc light; but it will be especially noticed that the lifting and separation of these carbons is not simultaneous. One pair is separated before the other, it matters not how little nor how short a time before. This separation breaks the circuit at that point, and the entire current is now passing through the unseparated pair of carbons A^1; and now and then the lifter, continuing to rise, separates these points, the voltaic arc will be established between them and the light thus produced.

" It will be apparent by the foregoing that it is impossible that both pairs of carbons AA^1 should burn at once, for any inequality of weight or balance between them would result in one pair being separated before the other, and the voltaic arc would appear between the last separated pair. This function, so far as I am aware, has never been accomplished by any previous invention, and by thus being able to burn independently and one at a time two or more carbons in a single lamp, it is evident that a light may be constantly maintained for a prolonged period without replacing the carbons or other manual interference. In the form of lamp shown, I can, with twelve inch carbons, maintain a steady and reliable light without any manual interference whatever for a period varying from fourteen to twenty hours.

"It is for some reasons desirable that one set of carbons —say the set AA—should be consumed before the other set commences to burn, although it is not essential, in carrying out my invention, that the carbons should be consumed in this manner, inasmuch as, if desirable, they may be arranged to burn alternately instead of successively. It is apparent, however, if one set of carbons can be made to entirely consume before another set begins to burn, that there will be less interruption in the light than if the different pairs were allowed to consume in frequent alternation. I have therefore shown, in the present invention, one method of securing a consumption of one set of carbons before another shall begin to burn. This I accomplish through my suitable support K, and in such a construction of the lifter D that it shall be positive in its function of separating one set of carbons before the other; or in case where more than two sets of carbons are employed, to separate said sets successively.

"In the lamp as shown in the drawings, the support K is in the form of a tube surrounding the carbon holder B, and this support K is made of such a length that when the carbons A^1 shall have been sufficiently consumed a head upon the carbon holder B will rest upon the top of the support K, whereby the weight of the carbon holder B and its support K shall at all times and under any circumstances be supported by the lifter D.

"Besides the carbon holder B, with its carbon, and the support K, the lifter D (when the lamp is in operation) should also be made to carry the carbon holder B^1 and its carbon.

"The lamp is primarily adjusted so that the magnets through the lifter D shall always carry a definite load, to-wit (in the lamp shown) the carbon holders B and B^1 and support K. The desirability of this construction and arrangement may be explained as follows: Supposing, as is designed in the present instance, the carbons A are first consumed. During this time, of coure, the magnets are lifting both carbon holders BB'. Now, when the carbons A are consumed, if no provision is made to the contrary, the carbon holder B would not be lifted during the consumption of the carbons A', and this diminishment of the weight carried by the magnets would be liable to materially disturb the adjustment of the lamp and impair its operation accordingly. To obviate this difficulty I have provided the support K, by which provision the magnets shall be made to carry both carbon holders BB' and the support K. The difference in weight, owing to the consumption of the carbons, is a practically unimportant matter, and does not materially interfere with the operation of the lamp.

"In the case of a lamp where the carbon holders BB' are very light and where the weight of one might be relieved from the magnet (or other moving agent) without material disturbance, the support K might be dispensed with. Said support K might also be omitted, if desired, in a lamp where the lifter is actuated through the agency of the expansion of the metal wire or bar by the action of heat generated by the current operating the lamp, inasmuch as the force due to said expansion being practically irresistible, it would not be so necessary to obtain a balance between the various parts as is the case with a lamp as shown in the drawings..... ...

"Thus far I have mentioned but two ways of imparting dissimultaneous motion to the carbons of an electric lamp—viz: Through magnetic attraction and through the expansive action of heat. This function of my device may be accomplished by clock work or equivalent mechanical contrivance; and in this respect, as before stated, I do not limit my invention.

'LL' are metallic hoods or protectors for inclosing and shielding the upper projecting ends of the carbon holders BB^1.

"In the form of lamp shown in the drawing I obtain very satisfactory results by constructing the helices E according to letters patent No. 212,183, granted to me Feb. 11, 1879. In each helix E two independent wires surround the lifting magnets E', one of fine and one of coarse wire, and each placed in the general circuit operating the lamp. These two wires (the fine and the coarse) are constructed and connected in such a manner as to carry current in opposite directions around the inclosed core, thus exerting a neutralizing influence upon each other, whereby a governing function is secured for a better description and understanding, of which reference is made to said patent No. 212,183.

"The poles of the lamp shown in the drawings are constructed in the form of suspending hoops or loops, from which the lamp is suspended, and the corresponding hoops or loops, with which they engage in the ceiling (or other locality where the lamps are used) are the positive and negative poles of the current generating apparatus. Thus, by the simple act of suspension, the lamp is placed in circuit.

"I will now specify a construction whereby the protecting globe surrounding the light can be raised and lowered for convenience in renewing carbons and handling the lamp. This I accomplish by making the platform of gallery O, upon which the globe rests, vertically adjustable upon a rod O^1, attached to the lamp frame in any convenient manner. A set-screw should be provided, whereby the globe can be adjusted to any desired position. By this arrangement the work of renewing carbons and the reliable adjustment of the globe in relation to the voltaic arc are materially assisted.

"In order to accommodate long sticks of carbon, the platform or gallery O should be perforated to allow passage down through it of said carbon sticks. I prefer making the platform or gallery O of metal, and of such shape that globules of molten copper from the coverings of the carbons, in dropping away, shall not escape to do damage.

"It will be particularly observed that in the form of dash-pot employed the cylinder is the movable and the piston or plunger the stationary element. This construction implies more than a mere reversal of the usual make and operation of the dash pot, for by making the cylinder the movable element the general construction of a lamp can very often be materially simplified, as in the present instance. This form of dash-pot is designed to be employed in connection with any of the moving parts of the mechanism of an electric lamp where it is desired to retard a downward movement."

The lamp covered by patent No. 203,411 is referred to only for the purpose of illustrating the operation of the invention in suit and the complainants' right, to the relief prayed for does not depend upon the validity of this patent. The lower carbon of this lamp is held in a fixed position and its upper carbon is carried by a sliding rod which passes through a ring clamp just large enough to permit it to slide freely through when the clamp lies flat on the floor of the regulator case, but which binds upon the rod when it is lifted by one edge. The lifter which is upon the edge of the clamp is attached to a soft iron core which plays inside a wire helix, through which the current producing the light circulates. The attracting strength of this coil is proportionate to the strength of the current flowing through it. When there is no current flowing through the lamp the coil has no attraction at all, and the core consequently rests at the lowest limit, and the ring clamp lies flat on its floor. In that situation the carbon rod slips freely through the clamp and the upper carbon rests in contact with the lower one.

Upon the establishment of the current through the lamp it passes through the carbons with little resistance because they are in actual contact. The circuit is, therefore, a strong one and energizes the coil strongly and it in turn attracts the core strongly and pulls it downward. This movement being communicated to the lifter it, in turn, first lifts the ring clamp by one edge; this causes it to impinge closely upon the rod, and then lifts the rod and carbon and so separates the carbon points. This establishes the arc. But the arc introduces a resistance to the current which diminishes its strength, the resistance increasing as the arc grows longer. Hence, as the arc lengthens by the consumption of the carbons and the increase of the space between them, the current grows weaker, and the attracting power of the coil diminishes until it lets the core move downward sufficiently to release the grasp of the clamp on the rod, so that it slips downward. As the upper carbon approaches the lower and so shortens the arc and diminishes its resistance the current's strength increases, the coil again pulls the core upward and so tightens the clamp upon the rod, and this holds the upper carbon suspended at its normal distance from the lower. This process goes on until the carbons are consumed.

It will be observed from the description of the lamp in suit that when the current is first passed through it, the current divides at the lamp and passes through both pairs of carbons and instantly energizing the solenoids, draws upwardly the cores, and through the bar E, link E, lever E and lifter D, separates the pair of carbons A'. The separation of this pair of carbons does not operate to break the circuit and form an arc between them, but simply diverts the entire current through the remaining and unseparated pair of carbons A. The lifter D, continuing to rise, next separates the carbons A, thereby interrupting the circuit and establishing the arc between the last separated pair of carbons A. After the arc has been established between one pair, the carbons of the remaining pair are held separated by the ring clamp, their initial separation being such that the idle pair will be retained in their separated relation while the regulator automatically moves and adjusts the burning pair, to separate or approximate them, as the conditions may require to regulate the length of the arc, and also to automatically feed them to maintain the arc. When the burning pair of carbons has been consumed the effective pull of the solenoids is diminished to such an extent that the carbons of the idle pair are brought into contact which causes the entire circuit to be instantly diverted through them, the effect of which is to strengthen the solenoids and separate the carbons, and automatically establish the arc between them.

The separation of the two pairs of carbons, so that the arc is established between one pair and maintained between the carbons of that pair until they have been consumed, and then automatically established between the carbons of the other pair and maintained between them until they have been consumed, is a dissimultaneous and successive arc-forming separation and it is this feature which distinguishes the lamp in suit from all prior lamps.

The six claims of the patent which it is alleged are infringed, read:

"1. In an electric lamp two or more pairs or sets of carbons, in combination with mechanism constructed to separate said pairs dissimultaneously or successively, substantially as and for the purpose specified.

"2. In an electric lamp, two or more pairs or sets of carbons, in combination with mechanism constructed to separate said pairs dissimultaneously or successively and establish the electric light between the members of but one pair (to wit, the pair last separated) while the members of the remaining pair or pairs are maintained in a separate relation, substantially as shown.

"3. In an electric lamp having more than one pair or set of carbons, the combination, with said carbon sets or pairs, of mechanism constructed to impart to them independent and dissimultaneously separating and feeding movements, whereby the electric light will be established between the members of but one of said pairs or sets at a time, while the members of the remaining pair or pairs, are maintained in a separate relation substantially as shown.

"4. In a single electric lamp, two or more pairs or sets of carbons, all placed in circuit, so that when their members are in contact the current may pass freely through all said pairs alike, in combination with mechanism constructed to separate said pairs dissimultaneously or successively, substantially as and for the purpose shown.

"5. In an electric lamp wherein more than one set or pair of carbons are employed, the lifter D or its equivalent, moved by any suitable means, and constructed to act upon said carbons or carbon holders dissimultaneously or successively, and substantially as and for the purpose shown.

"6. In an electric lamp wherein more than one pair or set of carbons are employed, a clamp, C, or its equivalent, for each said pair or set, said clamp C, adapted to grasp and move said carbons or carbon holders dissimultaneously or successively, substantially as and for the purpose shown."

It is admitted by the defendants' counsel that the patent in suit describes a new and useful mechanism for which Brush was entitled to a patent, but it is urged that the first, second, third and fourth claims are for functions or results without regard to mechanism, and are therefore, void.

The claims are not open to this objection. The specification describes mechanism whereby a result may be accomplished, and the claims are not for mere functions, nor fairly construed, can it be said that they cover other than equivalent means employed to perform the same functions. The first claim, construed in connection with the means described in the specification, is for an arc lamp in which two or more pairs of carbons are used, the adjustable carbons or each pair being independently regulated by one and the same mechanism, and in which there is a dissimultaneous or successive separation of the pairs, so effected as to secure the continuous burning of one pair prior to the establishment of the arc between the other pair. Thus construed, the invention claimed is limited to the particular means described in the specification and their substantial equivalents.

The second, third and fourth claims also refer to the particular mechanism described in the specification for the accomplishment of results covered by these claims. They are for combinations of specific mechanisms, and their substantial equivalents, and not for results irrespective of means for their accomplishment.

It is true that in the specification Brush declared, "I do not in any degree limit myself to any specific method or mechanism for lifting, moving or separating the carbon points, or their holders, so long as the particular functions and results hereinafter to be specified shall be accomplished."

He did not say, however, that he claimed all mechanisms irrespective of their construction and modes of operation. By this language he simply notified the public that he did not restrict himself to the particular lamp described in the patent, but that his invention embraced *that* and all other lamps operated substantially the same way by equivalent mechanism.

It is urged that the fifth claim covers the lifter simply, and that the sixth claim covers nothing but the clamps and being only for detached parts of the lamp, incapable of separately performing the functions ascribed to them and these claims are void.

The fifth claim is for a combination of which the lifter D is an element, and thus construed, the claim is for a novel and useful invention.

The sixth claim is not for the two clamps aside from other connected mechanism. It is for the two clamps in combination with the mechanism described in the patent for actuating the clamps and causing them to grasp and move the carbons dissimultaneously, substantially as and for the purpose described in the specification.

Patent No. 147,827, issued to Matthias Day, Jr. February 24, 1874, is relied on as an anticipation of the first, second, and fourth claims of the patent in suit. This defense is based upon a construction of these claims that gives no effect to their concluding restrictive language, which construction, we have seen, is not authorized. The patent in suit describes mechanism which designedly and positively effects a dissimultaneous separation of the carbons, and Professor Barker, the defendant's expert, testified that the Day lamp was not so constructed, and did not so operate. It is true that the Day patent describes a lamp which contains two or more pairs of carbons, but not such a double carbon lamp as Brush invented. In the Day lamp each carbon is split or divided vertically for a slight distance from the outer end, but so rigidly connected at the clamp extremity as to act solely as a pair of separate carbons, and not as "two or more independent pairs or sets of carbons."

Owing to the constant and frequent shifting of the arc from one pair of carbons to the other in this lamp it produced an irregular and unsatisfactory light. It was unlike the Brush lamp both in construction and mode of operation.

The answer also denies infringement, but that defense, like the last one, is based on the theory that the claims are not at all limited by their concluding language. It is plain from the evidence that the defendants' lamp was designedly constructed so as to insure the dissimultaneous separation of the two pairs of carbons for the purpose of forming the arc between one pair only of the carbons, and that both lamps operate in identically the same way and for the same purpose. The patent describes a ring clamp and the defendants use a hinged clamp, but there is not the slightest functional difference between them. Both operate by grasping and holding with varying pressure the smooth rod which carries the carbons, thus allowing the rod a slide so as to secure a continuous feed by inappreciable degrees, while, under other conditions, the rod is allowed to slip suddenly by gravity. The ring clamp was old, and Brush simply employed it as suitable for his purpose in combination with other elements with which it co-acts, and the substitution of the hinged clamp, without any change in the mode of operation or function, did not change the combination.

In the Brush lamp the clamps rest on a flat floor, and the arms of the lifter are of unequal length so that when the lifter is raised, one clamp is tilted in advance of the other, and the carbons are separated dissimultaneously. In the defendants' lamp the same result is accomplished by supporting the clamps in different planes, and employing a lifter with arms of the same length, so that in the operation of the lifter it will tilt one clamp in advance of the other. Brush did not claim that there was invention in the lifter and clamps disconnected with other parts in the operation of the lamp, and the defendants cannot escape infringement by showing that they use a lifter and clamps not identical in construction with the lifter and clamps described in the patent. It is admitted that, if the claims are construed as embracing the mechanism described in the specification, the defendants use a lamp covered by the patent in suit, and that renders a further description of defendants' lamp unnecessary.

It is finally contended that, while the patent describes particular mechanism by which the functions stated in the claims can be performed, the patentee expressly declared in his specification that he did not limit himself to this mechanism, or its equivalent, but claimed that his invention comprehended all means capable of accomplishing the results stated, and that having thus claimed more than he was entitled to, the complainant cannot recover until he disclaims everything in the specification except the specific mechanism.

An application for letters patent is accompanied by a specification giving a full general description of the alleged invention, and this is followed by what is known and well understood in the courts, as well as the Patent Office, as a "claim." What the patentee invents and describes in his specification, but fails to embrace in his claim, he abandons to the public, unless by timely application he obtains a reissue for it, and if in the descriptive part of his invention he inadvertently, or otherwise, includes as a part of his invention that which is old, but does not claim it, his claim is not thereby invalidated. Such part of the specification is surplusage. It is only when the claim following the specification is too broad, in the sense of embracing something as new, which is not new, that the patentee is required by Section 4922 to disclaim. He is not required to disclaim anything in the specification not covered by his claim. The word "specification" is obviously used in the first clause of Section 4922 as synonymous with "claim." I am aware of no decision holding that a patentee is required to disclaim anything in the descriptive part of his invention which is not fairly embraced within his claim.

In Railroad Company vs. Mellen, 104 U. S. 118, the court said: "In view, therefore, of the statute, the practice of the Patent Office and the decisions of this court, we think that the scope of letters patent should be limited to the invention covered by the claim, and that though the claim may be illustrated, it cannot be enlarged by the language used in other parts of the specification. We are, therefore, justified in looking to the claim with which the specification of the appellee's invention concludes, to determine what is covered by this letters patent."

It is not material for the purpose of this suit whether Brush was a pioneer, or a mere improver. It is sufficient that he described and illustrated in the patent in suit a specific mechanism, or double carbon lamp, adapted to burn its carbons independently and successively; that he was the first to accomplish this result, and that the claims are for mechanism substantially as described in the patent in combination with two or more pairs of carbons or sets of carbons for producing the result specified. We have already stated that what is claimed is not functions and results, but mechanism for producing functions and results.

A decree will be entered in accordance with the prayer of the bill.

Cause of Subway Explosions.

Explosions of gaseous mixtures in the manholes connected with underground conduits for electric wires in the streets of New York have shown the necessity of adopting precautionary measures of some kind. Just what form these measures should take has proved a somewhat interesting problem.

As put down by the Consolidated Telegraph & Electric Construction company of New York, which is building the subways under contract with the Board of Electrical Control, the manholes, into which the pipe conduits lead, are closed practically air and water tight. There is no escape into the open air of the gases which leak into the manholes through the brick walls. Ventilating the manholes by having the covers perforated, as in the case of sewer manholes, is clearly out of the question, since holes left in the covers would admit water and dirt to the great detriment of the electric cables and connections. The Consolidated company is accordingly considering the plan of introducing compressed air into the manholes through a system of 6-inch air pipes, the air being under pressure—somewhere under five pounds per square inch—to prevent the entering of the manholes of gases at a lower pressure. The air is to be furnished either from one central compressor station or from a number of district stations.

There has been much speculation as to the way in which the gaseous mixtures are ignited in the manholes when explosions have come. Sparks from without could obviously not get into the holes owing to the form of covering used. Concussion due to heavily laden trucks passing over the covers, and sparks from the electric connections in the holes, have been considered as possible causes. One theory is that grains of sand, having become lodged under the covers near the inner edges of the manholes, have produced sparks from heavy loads passing over, but no definite conclusion has been arrived at. —*Engineering and Building Record.*

Electrical Engineering in America.[1]

BY G. L. ADDENBROOKE.

PART II.

UNDERGROUND WORK.

Turning now from this branch of the subject to underground work, I must confess that I had a good deal of difficulty in getting really accurate and reliable information on this subject—at any rate, of a comparative character. The Edison company have, of course, buried their wires all along, and their three conductors inclosed in an iron tube, run solid with insulating material inside, are well known. As far as I could ascertain, the various systems of conduits have not proved very successful so far, and, since the proof of the pudding is in the eating, the fact that the Subway company in New York are, I believe, laying down iron pipes entirely—at least, they were in every place I saw work going on—points to this conclusion.

The system of construction for underground work at present being carried out in New York is as follows:

Manholes at convenient distances are made in the roadway—not, as a rule, in the pavement, but just on the rise of the road, and clear of the gutter. These manholes are circular, and are covered by a heavy iron lid. Below the manhole is a bell-shaped pit 8 or 9 feet deep, and bricked round, and of sufficient size at the bottom for a couple of men to stand fairly comfortably to work. Iron pipes such as are used for water or gas, are laid in the ground from one manhole to the next. I understand that each electric company will, as a rule, have a separate pipe, so that if there are several companies running along the street, they will each require a separate line of piping opening into the manhole. There will, therefore, often be several pipes entering at each side of the manhole. These pipes enter the manhole at such a height as, roughly, to come between the hips and breast of a man standing on the bottom—at a height, in fact, to bring them in a fairly convenient position for working. The cables are drawn through the iron pipes in the ordinary way. Branches are taken from the manholes under the roadway and pavement to any house between the manholes requiring current.

As regards the class of cable which is being largely laid down in these conduits, the conductor consists of seven strands of No. 16 copper. These are insulated by a layer of a hard but somewhat flexible material, containing, I believe, some rubber in conjunction with other materials, but the complete material is cheaper than rubber used alone. The thickness of this material surrounding the conductors is one-twelfth of an inch. It somewhat resembles ebonite, and is of a consistency to stand rough usage and hard wear. It will be interesting to see how it lasts in practice. I must say it seems to me a very suitable material for the purpose for which it is intended; and as far as insulating qualities go, I was able to see the records of tests of a good deal that has been laid, and they were excellent, going up to several thousands of megohms per mile. The insulating material is covered with a lead pipe about one-sixteenth of an inch thick, and containing, I believe, a percentage of tin. These lead-covered cables are usually jointed at each manhole, and a little slack left on them there. The jointing is done by a special system, and when it is complete electrically the two lead tubes are drawn together over a bit of brass tube, which protects the point of junction; they are then "wiped" together with a hot iron like an ordinary plumber's joint. No doubt this work is heavy and expensive, but it looks as if it should last when once put down.

INTERNAL WORK.

Coming now for a moment to the internal work in buildings, most of what I saw had a rough, temporary look about it, evidently being put up as cheaply as possible. I do not say that no good, solid work is done, but the proportion of it to the remainder is, I fancy, a good deal smaller than in this country.

Gas fittings are freely utilized, and I think I am correct in stating that in the arrangement of lights the gas-fitting way of managing things is adhered to much more closely than in this country, where we have rather tried to avoid imitating the ordinary ways of arranging gas lights.

Turning aside for a moment, it appears to me that one of the great wants all over the world now is, if I may so term it, a "science of illumination." Up to and as far as *providing* light, we are exceedingly scientific But in *utilizing* it when we have got it we proceed in an elementary and haphazard manner.

Mr. Preece has, I know, from the first paid a great deal of attention to this point, and appreciated its value. It seems to me that it would really be of great practical benefit if a committee of this Institution, or some other responsible body, would accumulate some accurate or authoritative data on the subject. When once started properly, these data would increase of themselves, and would soon form a guide which would be exceedingly useful in drawing up specifications and arranging to the best advantage the lighting of either open spaces, public buildings, or private houses.

We all have our own indefinite notions on the subject as the result of experience, but if they could only be put into definite shape—and I think the subject does admit of being put into definite shape—it would, I feel sure, be a great advantage.

Of course there are innumerable patterns of switches and cut-outs and fittings in America, as here, but none came to my notice showing any very brilliant conception in design. Lamp sockets and fittings are generally somewhat larger and clumsier than with us.

The chief difference I noticed was that a switch is almost invariably included in each lamp socket. Americans, as a rule, do not go to the same amount of trouble and expense that is general here to fix switches in handy places near doors. If you want to light on or off, you turn it on or off at the burner as you would do gas.

[1]Read before the London Institution of Electrical Engineers.

CENTRAL STATIONS.

Coming now to central stations, those I went over were the new arc light station in San Francisco, the Edison station in Chicago, the Westinghouse station in Pittsburg, and the Thomson-Houston station in New York; and I may add that since my return to London I have had an opportunity of going carefully over the new Westinghouse station in Sardinia street, Lincoln's-in-fields, the plant in which is entirely of American manufacture and pattern, and arranged in the American manner.

I might easily have seen many more stations, in some cases perhaps larger and better arranged than those I did see. But those I did see are, I think, all typical of the latest American work, and all were in the process of making large additions to their plant, so that they were quite up to date.

The station in San Francisco is near the railway station. It is a large brick building, erected entirely for its present purpose, about 250 feet long by 80 feet broad, with a ground and two upper floors, and has been finished about eight months. It is intended to provide accommodations for about 2,000 arc lights when filled up. At present it is furnishing current for about 600. It is arranged in the usual—I was going to say invariable—American plan of placing the engines and boilers on the ground floor, and arranging the dynamos, switch-boards, and electrical portion of the station on the first floor. In this instance the second floor is used as a storehouse, and for general purposes.

The boiler house forms one end of the building, and there was nothing above it. It is arranged for two lines of boilers, one on each side, one side only being filled up at present They face toward the center of the building, with a large space between for coal and general working purposes. The boilers were of the well-known water tube pattern. This type, varied slightly in detail by each maker, seems to be in general use everywhere in the States. From the boilers the steam is led to a 650 horse power single cylinder Corliss engine, which, by rope gearing, drives a single line of counter-shafting. I must say I was surprised to find that, in a new station so large as this, and one in which expense evidently had not been spared, the engine was neither compound nor condensing, particularly as there was water within a moderate distance. There was only this one engine in the station driving all the dynamos, though space was provided for three more as the amount of lighting increased. The working of the station was therefore dependent on the single engine and line of shafting keeping in good order. The engine drove this line of counter-shafting as I have said, the loose pulleys being on the shafting. At the stations I visited where counter-shafting was in use I was struck with the care and completeness with which means were provided for adjusting the plummer blocks and bearings in any direction. The general idea was somewhat as follows: The plummer block, or upright, stood in a cast iron shoe with a flat planed bottom, through which the holding-down bolts projected. The holes for the holding-down bolts in the plummer block were bored large so as to permit a certain movement in the block. The edges of the cast iron shoe were turned up all round, and through these edges projected screw bolts, the points of which touched the plummer block. By loosening, then, the holding down bolts at any time, and screwing or unscrewing the screw bolts as required, the block could be slewed slightly or adjusted to line with the greatest nicety and ease. Besides this, the under bearing worked in guides, being kept in its place by a strong screw projecting up from underneath. By working on this screw, and on the cap of the upper bearing, the height of the bearing could, of course, be adjusted with great exactness. With these means the brasses are also quickly and easily replaced; while if they get warm when the shaft is running, the bottom bearing can be slacked down. The Thomson-Houston company in New York told me they did this, and their dynamos are on the same floor as the line of shafting. It is, of course, a still simpler and safer matter to do this when the dynamos are situated almost right above the shafting, as is the general practice in American stations. Leather belting of the ordinary description was in use, except for driving, where ropes are used, as I have mentioned. I found leather belting employed at each of the stations I visited.

These long lines of counter-shafting must, of course, be wasteful of power; still, it is worth pointing out that such shafting runs under the best conditions when doing work right overhead, since both the dead strain and the running strain on the belts to the dynamos tend to lift the line of counter-shafting, which, therefore, if the weight is properly adjusted, must run very lightly in its bearings.

The method of driving from underneath is also economical in belting, since the weight of the belt hanging on the dynamo pulley causes it to have a good grip, and permits of a short length being used. The belts pass up to the dynamos through holes in the floor, the holes being elongated to permit the belt being tightened, if necessary, by screwing the dynamo along on its bed rails.

In each of the stations I visited in America the upper floor carrying the dynamos was entirely of wood, strongly made, and supported from underneath at intervals by stout wooden uprights, but still of wood.

The weight of the floor in the San Francisco station is entirely supported by the wooden uprights, being only steadied at the sides. I was informed that at the old station in San Francisco, worked by the same company, and which, I understood, was supplying about 1,200 arc lights, a good deal of trouble was experienced from the floor, which was fixed to the walls, and which, vibrating with the motion of the machinery, shook the brickwork. I found the vibration on these wooden floors less than I anticipated, considering the amount of machinery on them; but, of course, the motion of a good dynamo is very even, and if the joints on the belt are neatly made there is no jerking.

In this San Francisco station all the machines were Brush 60-lighters. From 50 to 60 lights in series on one circuit seems to be about the general rule for lighting in America when any number of lights is required. As all the machines are run from the same counter-shafting, and at the same speed, whatever work they may be doing, it is necessary to provide an automatic regulator to adjust the current through the field magnets for each machine when doing less than its normal output. On the other hand, if the circuit is a very long one—and I was told some of the circuits at San Francisco are as much as 13 or 14 miles—the number of lamps on the circuit must be reduced to compensate for the extra resistance. These Brush dynamos were all mounted on short iron columns about 9 inches high, so that they were lifted entirely from the floor. I was told that this arrangement was found very handy for keeping the machines clear and free from dirt, and for inspecting them. I did not notice much difference between the machines and those turned out by our friends on this side of the water, and the style of the workmanship seemed to be about the same. A light overhead trolley, with lifting gear, ran overhead so that it could quickly be brought over any machine, and I was informed that should a machine go wrong they could replace an armature in half an hour. In the older station in San Francisco a large number of Thomson-Houston machines are used, but Brush machines only are employed in the new station, as they find the Brush armature is more easily replaced, and is so much the easier of the two to repair, if anything goes wrong. It is worthy of note in this connection that the latest advices from America inform us that the Thomson-Houston company has bought the Brush works at Cleveland, Ohio, and, therefore, presumably the Thomson-Houston company will in the future control this interest as well as their own.

From the dynamos the mains are led to a long, narrow shelf, where are fixed the resistances and indicating instruments for each machine The mains next proceed to the switch-board, which is of the plug pattern—brass plugs, with boxwood handles, united by a flexible insulated cord. All the flooring being of wood, as it is in each of the stations I saw, and being kept clean and dry, the risk of getting a bad shock is not great, except by shunting the current through oneself, or getting in series with a main which are not ordinary accidents.

At San Francisco the motor business is steadily increasing, and forms a welcome addition to the revenue of the station without a very great additional expenditure.

I will now go on to the Edison station in Chicago. There is no necessity to describe it at length, as the plans on which Edison stations are constructed have been published over and over again.

The boilers, which are situated on the ground floor, are of the water-tube pattern—Heine arrangement. In this pattern, which seems to be a good deal used, the tubes are much more nearly horizontal than in the well-known Babcock and Wilcox type. All the tubes come into a large flat box at each end, and there are small manholes in the boxes opposite the ends of the tubes for getting at them. These flat boxes are prevented from expanding with the pressure by tubular stays, which pass right through them and are expanded in their places. These small tubes serve as blow-holes for directing a jet of steam on the upper side of the tubes to clear them of ashes. They are kept plugged up with a stopper under ordinary circumstances to prevent the gases coming through. These boilers had a damper projecting downward in the furnace opening for directing the draught over the surface of the coal when firing, to cause more complete combustion and prevent smoke. This damper may have been of some use for the purpose, but it certainly made it a difficult operation to fire properly.

The engines were also in the basement, in the next room to the boilers. They were of the ordinary Armington-Sims pattern, single cylinder, and neither compound nor condensing. There was one to each dynamo, the dynamos being situated overhead on the floor above. The dynamos were of the ordinary Edison pattern for, I think, 1,500 lights each. Everything was very neatly arranged in the dynamo room, the current being conveyed about by large copper bars. The walls were simply lined with resistances and indicators for the different circuits. In fact, the place gave one rather the impression of a wholesale clock store, though the attendant informed me they did not have much difficulty in keeping their resistances properly adjusted. All the mains are underground, on the three-wire system. Indeed, there is a good deal of underground work in Chicago, the telephone company also having a large number of cables buried.

The next station I visited was that of the Westinghouse company at Pittsburg. It is situated in a large building of the warehouse type, quite in the center of the town.

The boilers here are of the water-tube type, but heated by natural gas instead of coal. This natural gas is brought in pipes to the town from a distance of thirty-five miles. The company who own the line of piping—of which, by the way, George Westinghouse is also president—sell this gas to manufactories, etc., at a rate which is nearly equivalent to the cost of coal, so that, although the convenience is great in using it, the economy is not so large as might at first be anticipated.

Work at the Pittsburg station was in the first instance begun with two Corliss single cylinder engines of the ordinary type, driving onto a line of countershafting; but this method of working has not been extended, and one of these engines has since been removed. The next additions to the station consisted of Westinghouse standard engines of 250 i. h. p., driving 2,500-light alternating dynamos. These engines stand on square blocks of concrete and masonry; the blocks for this sized engine are about 7x5 feet. The last additions are of the new type of Westinghouse compound engine. From a power point of view, as well as from an electric lighting point of view, the station has therefore something of historical interest.

While in Pittsburg I had an opportunity of going carefully through the Westinghouse engine factory with Ralph Bagley, the vice-president and manager, and of seeing all the details of construction of each of the different types of engines.

The Westinghouse Company make three styles of engine, each worked by a piston valve and single eccentric.

The standard type is so well known that I will not say anything about it. In it as you are probably aware the steam valve is between the cylinders and set at a slight angle to them, while the cylinders are set rather over their work, and not directly in a vertical line above the crank-shaft.

The junior and new compound engines are on somewhat different lines to the standard, while the main principles involved are nearly the same. In these two later types the piston valve lies horizontally along the top of the cylinder heads. It is operated by a single eccentric working outside the engine case in a vertical direction, the motion being changed to a horizontal one, by means of an L piece attached to the engine case by a hinge. The whole movement is of simple character and works exceedingly well. In fact, there are practically no more working parts in the compound engine than in the junior or the standard two-cylinder patterns, and the one is as simple as the other.

The standard type has now stood the test of several years' work very satisfactorily, and there is no room to doubt that the compound engine, constructed in the same shops and by the same method as the standard engine, will wear at least as well. The makers' tests show exceedingly good results for this compound engine—viz., from 18¼ pounds to 19¼ pounds of water per brake h. p. hour with condenser, and from 24 pounds to 25½ pounds without condenser. I saw the testing apparatus in the makers' shops and engines undergoing their test preparatory to delivery, and feel perfectly confident that the figures given by the makers are thoroughly reliable.

I will not describe this engine more fully, although to do so would probably elicit an interesting discussion, as it would be wandering from the subject of my paper. On the other hand, the remarks I have made are not intended to compare the Westinghouse compound engine with any other engine of at all similar type, but rather to draw the attention of electrical engineers to the fact that there are now, at any rate, two large firms of the highest repute turning out this class of engine, and ready to guarantee economy and efficiency on a par with Corliss engines.

CORRESPONDENCE.

New York Notes.

NEW YORK, December 28.—Last Monday Mr. Edison testified before the grand jury on the subject of electric lighting in this city. He suggested that a law be enacted prohibiting the use of electric currents strong enough to destroy human life, as he asserted that electric lighting could be conducted without them.

The United States Electric Illuminating company has sent a formal challenge to the Edison Electric Illuminating company, placing the "converter system" of the former against the "direct system" of the latter, as to economy and safety to the consumers. The investigation which the the challenge calls for is "to be conducted by a board of seven experts, three to be chosen by each company and the seventh to be chosen by the six so chosen; one on each side to be familiar with insurance matters and the others practical electricians."

The grand jury handed down a presentment some time ago stigmatizing the Board of Electrical Control as incompetent, but still by reason of the decision of Judge Van Brunt, which dissolves the injunction obtained by the electric illuminating companies, this body is allowed to carry on destruction of wires so far that not only are the electric illuminating companies suffering, but the whole city, which needs the light, especially at this holiday season of the year. Not only are the illuminating companies incensed against this destruction, but many of the prominent merchants and citizens are expressing their protests openly.

On Monday 28 miles of electric light wire were cut and 54 poles fell, and the work is progressing rapidly. The commissioner of public works has experienced difficulty in getting a sufficient number of experienced linemen, but since last week the electric companies have little use for their men and so the commissioner has taken advantage of this fact and engaged many of them. This will perhaps expedite matters.

The electric companies are of one mind in their determination to bring suit against the city and Commissioner Gilroy, and are only waiting until the destruction ceases in order to estimate the damage and bring suit for the proper amount. William H. Kelley, attorney for the East River Electric Light company, thinks the responsibility rests with Commissioner Gilroy, but that the Board of Electrical Control are imposing upon him. He says the East River company will sue for $250,000 or upward.

The Brown application for a mandamus to compel the Board of Health to take action against the high pressure current was heard in the Supreme court before Judge Lawrence. Col. Bliss appeared for the applicants and W. P. Prentiss and Corporation Counsel Dean for the Board of Health. Col. Bliss argued that the Board of Health had the power to interfere rather than the Board of Electrical Control. Mr. Prentiss said that the Board of Health was exercising its authority in the matter in directing the Board of Electrical Control by resolutions and orders to act in the premises, and there was no occasion to go further and produce a clash in authority. Judge Lawrence reserved his decision.

Gas is still leaking into the subways and explosions are imminent. A five-inch service pipe that carries a wire of the Manhattan company into the cellar of a store at the corner of Twenty-ninth street and Sixth avenue was so filled with gas as to blow out the wooden plug and an explosion was obviated only through the prompt efforts of the owner of the store. He tore off the covers of the coal holes and let out the gas into the street.

A benefit for Lineman Clausen's widow was given at Hardman Hall and over $200 was realized. The novelty of the entertainment was a short address pertaining to interviews with Thomas A. Edison in regard to danger and safety of electric wires.

Rapid transit on Broadway is still under discussion and the latest scheme is an overhead cable system. Three other systems were taken under consideration by the Board of Aldermen, but no action has yet been taken. The revival of the cross-town road through Fulton street is contemplated, but the electrical conduit system laid down in that thoroughfare some time ago will not be revived.

So many persons have been calling on Mr. Edison that he was obliged to post up a sign at his laboratory to the effect that "Mr. Edison is compelled to deny himself to visitors, as they have been so numerous lately he has been unable to give proper attention to his experiments."

The electrical execution machines were tested at the Sing Sing prison yesterday by a committee for the state, composed of Dr. Carlos F. MacDonald, Dr. A. D. Rockwell, Dr. P. H. Landy, and electrical experts. When the dynamos were run at less than their ordinary number of revolutions per minute the electrical pressure was found to exceed 1,600 volts. At 300 revolutions a minute it was estimated that the pressure would be more than 2,000 volts. Next week the committee will make tests of the dynamos at Auburn and Clinton prisons, and will probably experiment with a few animals.

The terrible storm which prevailed throughout New York state on December 26th did an immense amount of damage to overhead wires of all kinds.

Mrs. Olive E. Friend, Mrs. Emily Howard, George Halstead, and Orrin A. Halstead, defendants with William E. Hammond in the electric sugar fraud cases, have withdrawn their pleas of guilty before Recorder Smyth, and pleaded not guilty.

The Jersey City aldermen have given the Bergen Electric Light, Power & Heat company a franchise under which it can erect poles in all the principal streets of the city and run electric wires on them. Another electric light ordinance was introduced which allows the Consumers' Gas company to put up poles and run electric wires on them. This was referred to the committee on streets of the board.

W. H. T.

Kansas City, Mo.

KANSAS CITY, Mo., December 28.—E. R. Weeks of this city, the president of the National Electric Light association, said to the WESTERN ELECTRICIAN representative, that there would be between 400 and 500 electricians present at the convention February 11-14, many of whom had never been in the West. It will be the duty of the local committees to give them a good time. The general local reception committee consists of the following gentlemen: C. S. Rusling, chairman; Ira C. Hubbell, C. A. Ross, F. S. Caldwell, Edward La Salle, O. H. Schramme, J. W. Mason, M. E. Bates, W. W. Smith, M. D. Wood, H. C. Sprague and George M. Myers of Kansas City; Mr. Atterbury, A. H. Reese, and D. R. Russell of St. Louis; A. W. Malborn, Ft. Scott, and Thomas Officer, Council Bluffs. At a meeting of the local executive committee the following additional committees were appointed: On finance, C. A. Ross, Edward La Salle, George M. Myers of Kansas City; A. H. Reese, D. R. Russell, St. Louis. On printing and publications, H. C. Sprague, W. W. Smith, Ira C. Hubbell, Kansas City.

"Through to Argentine" is the banner that hangs on the electric cars at Sixteenth and Bell streets. A trial trip was recently made. The track was in fine condition, and the run to the Twenty-fourth street bridge, over a mile, was made in five minutes, and Argentine reached in seven minutes more. When Argentine was reached the entire city turned out, and cheered the car when it appeared. After a stay of a few minutes the party on board the car returned, making the home run in eleven minutes. The entire line was in perfect running order. There are nine cars on the electric road, six running through to Argentine, and three to Armourdale. The run from Kansas City, Mo., to Argentine, is made in about thirty minutes. Through the push and energy of General Manager McCarty the Argentine extension has been completed and cars are running nearly nine weeks ahead of the time required in the franchise issued to his company.

For eight months past Amos Mordis, a citizen of Hutchinson, Kan., and a railroad contractor of great experience, has been working quietly in this city and in Kansas City, Kan., toward the construction of an electric belt railway system, second only to the Metropolitan in size and cost. Work upon the road will begin within a month; the consent of a majority of the property owners along the proposed line has been secured. T. B. Bullene, L. R. Moore, George Sheidley and several other prominent citizens are at the bottom of the enterprise, which is one of the most important to the development of the two cities at the mouth of the Kaw, that could be presented. Franchises which were granted within the past few years to other companies and never used are in possession of the new company, and it is possible that an additional franchise, which will fill up the gap on certain streets of Kansas City, Kan., will be presented before the city council. It is understood that the new line is to act in conjunction with the Citizens' street railway, giving it the outlet on Wyandotte street which the Citizens' Railway has most needed to make it a paying investment. The road will cover twelve miles of double track and will require the construction of two bridges and a viaduct 3,000 feet long. The viaduct alone will cost $100,000, and the engineers estimate that the entire system of twelve miles will cost $500,000. Boston capitalists have looked over the ground and reported a few days ago that they would take the entire bonds of the company at 90 cents on the dollar. The line parallels the Metropolitan at nearly every point, having one important advantage over the Metropolitan, from the fact that it connects Wyandotte and Armourdale. The Metropolitan made a hard fight before the city council at Argentine to prevent its rival from securing a franchise, but the electric line carried off the franchise. It is claimed that a majority of the Kansas City, Kan., council have pledged themselves for the new line, and that a second victory will be scored soon.

The Kansas City Electrical society held its second meeting at the Midland hotel last week. The preliminary organization was made permanent. Regular meetings will be held hereafter on the first and third Saturdays of each month. The proceedings were enlivened by a brief address from Mr. Weeks, manager of the Kansas City Electric Light company, and also president of the National Electric Light association. Mr. Weeks assured the society of his hearty co-operation and assistance. Thomas F. Clohesey followed in a short speech. He believed the organization would prove of incalculable benefit to those engaged in electrical affairs, and promote the intellectual improvement of all concerned. Mr. Cutler of the *Electro-Mechanic* made a brief speech.

The Postal Telegraph & Cable company has completed the work of erecting its poles and stringing its wires between Kansas City and Topeka. The company has made application for a franchise in Emporia, Kan., which will be granted.

P.

Boston, Mass.

BOSTON, December 27.—A heavy gale of wind, unaccompanied by rain or snow, swept over this city and all of southern New England last evening. The wind was blowing from the west and at seven o'clock in the evening had attained a velocity of fifty-four miles an hour. Considerable damage was done to telephone and telegraph wires in many New England cities. At 9 o'clock this morning Boston had no communication with any points in Maine, New Hampshire and Vermont, and the Western Union had no wires to New York, either for commercial or general use. Communication was also cut off with Fall River, New Bedford and Newport. The trunk lines of the Postal Telegraph company to New York, Canada and the West escaped with very slight damage. The Boston telephone service is as satisfactory to-day as if there had been no storm, a result due to the efficient system of underground telephone conduits used by the company. In parts of Brookline and Cambridge the electric lights were extinguished, leaving the streets in darkness. Electric wires were blown down at Salem, Lowell, Fall River and Newport, and the Beachmont station on the Boston & Revere electric railroad was blown down and demolished. It is worthy of note that, notwithstanding the unusual violence of the gale, not a single wire of the West End Street Railway company's overhead construction was disturbed in the least, and no interruption to traffic occurred.

The long expected decision of the Lowell board of aldermen upon the petition of the two horse railroads in that city to use the overhead single trolley system was announced this morning. The right to use the single trolley system on about four miles of line was granted, certain rigid conditions, however, being imposed upon the railroad company. The petition asked for the right to use the single

trolley on all the horse railroad lines in the city, but permission to do this was not granted.

Mayor Hart is making a determined effort to reduce the price now paid by the city for its arc lights. After taking the advice of several experts as to the cost of arc lighting, he has held two conferences with representatives of the companies which have submitted bids for lighting the city with a view to securing a reduction in their bids. All bids so far made have been rejected, and the advertising for bids not to exceed 40 cents per light is due, the mayor says, in part at least to the result of his investigations on his recent western trip. The matter will be settled next Monday, the time when any new bids must be put in. It is expected that two companies will present bids for the 40 cent limit.

The open winter is most favorable to the plans of the West End Street Railway company to push forward the construction of their new power station and overhead lines. Hundreds of men are at work daily on the Central power station, though all of the work so far done has been below the surface of the ground. Excavation work, the driving of piles, and the laying of concrete foundations is going forward every day. It is expected that two of the 1,000-horse power engines will be on the ground and set up in the early spring. In the temporary plant near by the No. 5 McIntosh & Seymour 300-horse power compound condensing engine is being put in place to-day. Four of these generators are belted to 12 Thomson-Houston compound wound generators of the usual type, while the No. 5 engine will drive three generators of a new type which have just been received from the Thomson-Houston factory. These are 4-pole compound wound machines with Gramme ring armatures. The commutators are of very large diameter, and there are four carbon brushes for each armature. These machines are to a certain extent experimental.

It is reported that the purchaser of the Thomson European Electric Welding company's patents is the City of London Contract corporation, the purchaser of the St. Louis breweries, and other industrial enterprises in this country.

George W. Mansfield of the Thomson-Houston Electric company's railway department, gave a very interesting lecture last evening at Wells Memorial Hall, on "Electric Street Cars."

F. C. Child read a paper before the Boston Electric club last Monday night, on the "Loss of Power by Radiation of Heat from Steam Pipes."

Capt. Edward Brophy of the New England Insurance exchange, has been engaged by Mayor Jackson of Fall River to overhaul the electric wires in that city, to report defects, and suggest the best methods for stringing the wires.

On Tuesday, the day before Christmas, the receipts of the West End Railway company for its passenger traffic were $19,000 as against $18,000 for the corresponding day one year ago. Taking the average receipts per passenger at 4.961 cents, as given in the company's last annual report, this gives as the total number of passengers carried last Tuesday, 383,000. This is almost exactly 100,000 more than the average daily traffic for the year ending September 30th last. O. H. M.

Indianapolis, Ind.

INDIANAPOLIS, Dec. 28.—At a recent session of city council the chairman of the committee on street railroads read a letter from Superintendent Schaffer of the Citizens' Street Railway company, in which he asked that the ordinance as prepared, asking for an extension of the charter, be withdrawn. He assigned as a reason that the press of the city was opposed to granting an extension on the terms named. The matter was called up and amended in such a way that little of the original ordinance remained. The amendments allow the street car company to use either animal or other power for the remainder of the life of the charter, the company to keep the streets in repair for sixteen feet of roadway when double track is used and for eight feet in the case of single track; to be responsible for any damage resulting in case electricity is used; to put up wire in such a way as not to interfere with the telephone company's circuits; to put iron poles in the center of streets for holding conductors; to begin work in sixty days from the acceptance of the ordinance, in case electric motors are used, and to have five miles of road in operation in 1890. The ordinance was passed as amended. The aldermen passed the ordinance, as amended by the council, without opposition.

Mr. Schaffer declines to say at present what his company will do. The general opinion is that it will accept the ordinance and go ahead preparing for the introduction of electric motors in the spring.

A decision by one of the judges of the Superior Court, in the old Dudley cable road case, may have some bearing on the council's action. It reads: "The council has no authority to grant any company the right to operate a cable or electric line." The law under which the present company's charter was granted says it shall use animal power. This case has gone to the Supreme Court. M.

THE ELECTRIC LIGHT.

The plant of the Fremont Gas Light company has been sold to the Fremont Electric Light company. The amount paid was $41,000.

Belvidere, Ill., is about to establish an electric light plant. The central station will be equipped with Westinghouse alternating current apparatus for a capacity of 750 lights.

At a recent meeting of the Muscatine, Ia., city council William Bowen was granted a franchise to operate an electric light plant in the city.

The city council of Sheboygan, Mich., has awarded to the Thomson-Houston company a contract for city lighting at $90 per lamp. A plant will be erected by local capitalists.

A company for electric lighting was formed in Lynchburg, Va., some time ago, and the power house is now sufficiently advanced to receive one 750 light Westinghouse alternating machine.

The carbon setters of the Allegheny County Electric Light company of Pittsburgh left their places on a strike a short time ago. The company and the men had a meeting, and the controversy was adjusted.

The Electric Light company of Hays City, Kan., has concluded to enlarge its plant by adding a 500 light Thomson-Houston incandescent dynamo, and a 50 horse power Westinghouse engine. The work will be completed within thirty days.

The first dynamo of the new Westinghouse arc light system was sold to the East End Electric Light company of Pittsburg, Pa. G. P. Shane, the secretary of the latter company, stated a few days ago that the running of the machine has so far been exceptionally even and without a fault, whether operating a short circuit or its maximum capacity of lamps. The machine is a 60 light dynamo.

A dispatch from Jamestown, N. Y., says: Several weeks ago at a special election, a proposition to bond the city in the sum of $25,000 for a municipal electric light plant was voted down. The council, on petition of citizens, ordered another election, which was held to-day, and those favoring bonding won by 39 majority. If an attempt is made to issue bonds the matter will go into the courts, as the local electric light company contends that the second special election is illegal.

The Light & Water company of Tacoma is moving its plant from its old to its new power house. The demand for lights has increased so great that recently the company had to build a larger power house in order to supply the demands. The company has two plants at present, and they will be located in the new quarters. These two plants are for arc lights and the incandescent lights. The company now have over 500 arc lights in the city, and there will soon be about 5,000 incandescent lights, varying from ten to fifty candle power.

The electric light has found a curious use in Russia, viz., for illuminating saintly images in cathedrals. Thus a magnificent figure of the Madonna, just placed in the Alexander Newsky-monastery, loaded with precious metals and gems of immense value, stands glitteringly in the focus of an electric beam, which is also the case with the "Kasan" Madonna in St. Petersburg. From near and afar thousands make pilgrimages to these shrines. It has been decided to so illuminate the ancient monastery of St. Ursula at Olmutz, the first instance on record of its use exclusively in a monastery.

The Westinghouse Electric company has closed a contract with the Willamette Falls Electric company of Portland, Ore. The Portland corporation intends to light the streets and houses of that city, and will establish a central station plant and equip it with Westinghouse alternating current machinery for a capacity of 6,000 incandescent and 100 arc lamps. The central station it is proposed to erect at Willamette Falls, a distance of twelve miles from Portland, as the company wishes to utilize water power in the generation of the electric current. From the station the current is to be carried to a branch station in the city, and from here it is to be distributed. Owing to the long distance the current is to be carried previous to its distribution, the Westinghouse company will make special apparatus capable of generating a current of 4,000 volts. The arc light machine chosen by the Portland company is that just brought out by the Westinghouse company, and the entire number of lights is to run from one machine.

The Omaha *Bee* says of the electric light masts in Council Bluffs: "The two eighty-foot electric light masts, located in the southern part of the city a short time ago by the city council, were lighted last evening for the first time. The poles are set five feet in the ground, which brings the lights seventy-six feet and eight inches above the level of the street. On each is placed two 2,000-candle power Sperry arc lights, and the result of last evening's experiment showed that the new system will be a success. Two of these masts take the place of a 150 foot tower and four lights, and a larger territory is illuminated much more brilliantly. The light is thrown fully six blocks, and the space near the masts is more brightly lighted than the same distance from one of the towers. As the cost is much less than a tower, the new method bids fair to entirely supplant the tower lights. President Wright of the electric light company was immensely pleased with the result, and the citizens who reside in that part of the city are jubilant."

THE ELECTRIC MOTOR.

The Key City electric railway at Dubuque, Ia., operated by the Sprague system, was successfully started on December 24.

The city council of Boone, Ia., has been asked to grant the local street railway company the right to run its cars by electric power.

Articles of incorporation have been filed by the Merrill Electric Street Railway company. Nothing will be done this winter, except to contract for the material. The construction of the road next year is assured it is said.

The directors of the Milwaukee City Railway company have decided to employ electricity on their entire line. The cost of the change will reach the sum of $400,000. The change will not be completed before next fall. The work will be commenced shortly.

John Webber of Des Moines, Ia., has purchased the street railway line at Atchison, Kan. He will operate the line as it is until April, when he expects to have it ready for operation by electric motor. He will put men at work setting the poles and stretching the wires at once.

It is stated that arrangements have been completed with a party of Eastern capitalists for the construction of a complete system of electric street railways in Lincoln, Neb. The particulars in the case have not yet been made public, but it is understood that the enterprise is backed by ample capital, and that it is to be a go. Operations are to begin in the spring.

A Springfield, Mass., paper says: "The proposed electric railroad between Athol Highlands and Orange has taken shape so far as to have begun the formation of a corporation. President W. G. Benedict of the Boston & Revere Electric railroad, and Mr. Ferguson of the Thomson-Houston company have been in town, and say that outside capital is available if a local corporation can be formed to secure a charter and the necessary franchises."

Among the charters recently filed with the secretary of state at Topeka, Kan., was one incorporating the Electric Railway, Light & Power company. The incorporators were D. C. Metsker, R. R. Moore, A. B. Wolverton, D. O. McCray and W. E. Sterne. The company was organized by electing W. E. Sterne president, and D. C. Metsker secretary, treasurer and general manager. The capital stock is placed at $150,000, divided into 1,500 shares of $100 each. The company is organized for the purpose of constructing an electric railway at Sedalia, Mo.

The electric railway at Rochester, N. Y., has proven so popular that other enterprises of the same character are now contemplated. A stock company with a capital of $80,000 has just been formed to construct an electric road from Ontario Beach to Manitou Beach, a distance of seven miles. These points are summer resorts within easy reach of Rochesterians, and the projectors of the new enterprise are confident of success. A double track will be constructed, and an overhead system introduced. The new company hopes to have the line in operation at the opening of the season.

A resident of Spokane Falls, Wash., who was in Chicago last week, said: "That the town is growing so rapidly in spite of the present disadvantage is an indication that it is the place for a big city. The immense water power of the falls, which far surpasses the power at Minneapolis, is being used to run dynamos. Electricity for power is being used all over the city. It is cheaper to have an electric motor than a steam engine. The street cars are run with electricity and the whole town is lighted with arc and incandescent lights. The power is practically unlimited, and electricity can be generated for almost nothing."

A Minneapolis Sunday paper says: The electric motor cars on the Fourth avenue south line will begin running to-morrow, probably. The company has had its men employed in running the cars for some little time, and the men are now well acquainted with their workings. Three cars took the members of the city council out on a trip yesterday morning, leaving the postoffice at 11 o'clock and arriving at the Thirty-fourth street terminus in 16 minutes after the time of departure. All of the aldermen were highly delighted with the new style of locomotion, and have no doubts about its success if the obstacles of snow and ice can be overcome.

A Kansas City paper says: "A trial trip has been made on the Argentine extension of the Metropolitan company's electric street railway. The trip proved a success in every sense of the word. At two o'clock car No. 80 filled with street railway officials, started to make the first trip on the new line. The trip to and from Argentine, a distance of four miles, was made in twenty-three minutes and everything worked to perfection. Some trouble was anticipated at the several curves and grades, but when the train reached these points it sped along without any difficulty whatever. As the train rolled into Argentine it was welcomed by a large crowd of enthusiastic citizens who had collected on the streets awaiting its arrival. Regular trains will be placed in operation and will run ten minutes apart."

It is expected that within a month work will begin on a great electric belt railway system of this city and Kansas City, Kan., says a Kansas City paper. Amos Mardis of Hutchinson, Kan., has been interesting capitalists in this for some months, and among those who are in the syndicate are T. B. Bullene, L. R. Moore and Geo. Sheidley. The new line will start at Tenth and Wyandotte, with the Tenth street line extended from the Main street line to Wyandotte, extend thence north to Fourth and thence to the river, on land which has been reclaimed for that purpose. The river will be bridged so as to let the road into Kansas City, Kan., on Seventh street, and on that to the Quindar boulevard. The line will also take in Armourdale, crossing the Kaw on the old county bridge, running on around to again cross the Kaw south of Kingan's packing house, and coming back over the bluff, entering Wyandotte street at the north. The line will cover twelve miles and will cost with the bridge, $600,000. The line will run

parallel with the Metropolitan, but will have the advantage of connecting Kansas City, Kan., and Armourdale.

The following is from a Cleveland paper: The most inspiring sight that has greeted the eyes of the street car patrons for some time was the recent exhibition of the Woodland & West Side company's storage battery. It was the first trip from Wilson avenue to the Lorain street terminus, and the trial had been anticipated with lively interest. There was no test of speed, but the object was to try the power in a trip of half a dozen miles, and to ascertain whether any defect would be developed in such a trial. The test proved a most gratifying success. The motor followed the horse car that left the barns at Woodland and Wilson avenues at 9:52 o'clock. Incandescent lights were displayed outside at the ends of the car, and the interior was also illuminated by electricity. The car reached Bank street at 11:19 o'clock, two minutes behind the schedule time, and the horse car was ahead by more than a block, but it was easily overtaken just west of the viaduct draw. The experimental car is an old one which has been fitted up for the trial. If this test was an ordinary performance, the system will probably be adopted by the West Side & Woodland Avenue company. It is said that if the company adopts the battery the road will be equipped with cars twenty feet in length, and that no tow cars will be used.

The Rochester, N. Y., *Sunday Herald* speaks to the point when it says: "Citizens of Rochester are manifesting considerable interest in the subject of more rapid surface transit in this city under the management of the new street car company. The only methods that have elsewhere proven to be superior to horses are the cable and the electric systems. Taxpayers who have taken the trouble to make an independent investigation of these two methods are not slow in giving their preference to electricity as a motor. The laying of a cable means a bad tearing up of the streets, and it is claimed that East Main street bridge would be weakened by cutting into it sufficiently to put down a cable for street car propulsion. Especially difficult would it be also to cross the canal by the cable system. With electric wires, however, it would be an easy matter to span the canal crossings and there would be very little tearing up of the streets, in fact not more than enough to set poles near the curb. The new company's committee is busily engaged on the subject of a motor that will give more speed to the cars and do away with horses. The men who have that matter in hand are charged to make their examination very thorough and complete. If they consult the wishes of a majority of the citizens they will not attempt to introduce the cable system here, because, as the feelings of taxpayers now stand, such a plan would meet with very determined opposition."

THE TELEPHONE.

It is stated that the Pittsburgh Telephone company proposes to institute suits against the Allegheny Electric Light company and against the company operating the electric railway in Allegheny. The allegations are that the electric light wires are insecurely fastened, and that they fall across the circuits of the telephone company and burn out instruments. It is alleged also that a large number of telephones have been rendered useless by noises arising from the proximity of the railway wires.

THE TELEGRAPH.

The following was sent by a correspondent of a daily paper in the City of Mexico: "An English company recently made an offer for the government telegraph lines, which was refused. The same company now asks for the concession of a line to the Gautemalan frontier, with branches through the country east and west. It also proposes to establish lines throughout Central America."

The Western Union Telegraph company has been sued by T. R. Tobin, contractor and builder, of Seattle, Wash., for $6,483 damages for wrongly transmitting a message. A telegram addressed to Tobin stating that "Sallie (his wife) sailed Saturday" was given to the company for delivery, and when Tobin received it the dispatch read "Sallie died Saturday." A few days later however, Tobin received information that his wife had sailed for Tacoma. Plaintiff had two contracts when he received the misleading message, which he had to give up because of his inability to attend to them on account of the shocking news, and owing to his loss, together with the mental anguish endured, he demands satisfaction in the above amount.

The women of the Russian telegraph service are raising a great outcry in the press against the hardship of the law in force in Russia that they may only marry telegraphists, and that, too, only those who are engaged at the same station, the official idea being that they thereby, in case of need, would be able to take the places of their husbands. A young Russian woman writes to a Novgorod paper: "I have, therefore, if I do not choose to forfeit my situation, first to fall in love with an electrical swain, then to manage that he falls in love with me; next to arrange that he is transferred to my station. This is a hard task for a girl who is riveted fourteen hours every day to her apparatus and does not wish to lose her p ttance of 720 roubles a year."

Business Mention.

The Easton Electric company of 45 Broadway, New York, has just issued a handsomely illustrated catalogue descriptive of its electric light system.

The Pond Engineering company will furnish a complete steam plant of 75-horse power for Murphysboro, Ill. The company has shipped a 150-horse power Armington & Sims engine to the Edison Electric Illuminating company of New Orleans, making the sixth engine furnished the company. The Pond Engineering company is furnishing a 50-horse power boiler for the ice factory at Corpus Christi, Texas, an automatic feed pump and receiver in Kansas City, and leather link belt to the Holden, Mo., electric plant, and the St. Louis Smelting & Refining company.

The Wainwright Manufacturing company of Boston, have furnished the following electrical plants with our corrugated copper tube feed water heaters recently: Canada Electric company, Nova Scotia; Edison Electric Light company, Philadelphia; North Attleboro Steam & Electric company, Mass.; Marr Construction company, Mass.; Lewiston Electric Light & Heat company, Ill.; Belfast Electric Light company, Maine; Denver Tramway company, Colo.; Greensburg Electric Light company, Ind. The company reports that business is rushing in heaters, condensers, expansion joints and separators.

John G. Boyd of the Queen City Electric company of Cincinnati, O., has been booming the business of that company recently in St. Louis, Mo. In addition to the eleven motors previously placed there, Mr. Boyd has recently consummated sales for incandescent lighting plants as follows: Mound Coffin company, 150 lights; Hall & Brown Wood Working Machine Manufacturing company, 150 lights; Logeman Chair Manufacturing company, 168 lights; Campbell Manufacturing company, 100 lights. The construction work for these plants has been done all in accordance with the recently perfected New England rules; nothing smaller than a No. 16 wire is used in any case, and all cleats dipped in P. & B. paint. The Davis dynamo is rapidly forging its way to the front and the Queen City Electric company is compelled to run its factory all night to keep pace with the demands.

The following letter has been received from A. F. Blundell, receiver of the Midland Electric company of Omaha, Neb.: "The business of the Midland Electric company has this day been placed in my hands as receiver appointed by the United States court. By way of making a brief explanation as to what has led to this result, I would say that since the business of this company was placed in my hands last April, when I was appointed general manager, our books show that we have been doing a very profitable business, but the burden of old indebtedness I finally found was more than we could longer carry. The company at present, aside from the old affairs, is in a prosperous condition, having a number of outstanding contracts which will none of them pay less than a net profit of 25 per cent., and in many cases exceed this amount. They have made a reputation for good and reliable work, the principal employes are thoroughly practical and experienced men and hard workers. With a little time the business can be cleared up in a manner satisfactory to all concerned. All bills for goods hereafter ordered by me as receiver will be paid when due, payment being secured by the United States court through my bondsmen."

The Ball Engine company of Erie, Pa., made the following shipments during the month of December: The Bronklyn Street Railway company, Cleveland, O., three 125-horse power engines; Redonda Hotel company, Los Angeles, Cal., one 100-horse power engine; Tatum & Bowen, San Francisco, Cal., one 25-horse power engine; Townsend Electric Light company, Port Townsend, Wash., one 100-horse power engine; United States Improvements on the Mississippi River, one 80-horse power engine; Atchison Gas & Electric Light company, Atchison, Kan., one 125-horse power engine; Buffalo Street Railway company, Buffalo, N. Y., one 125-horse power engine; Haverhill Electric Light company, Haverhill, Mass., one 125-horse power engine; The New Castle Steel company, New Castle, Pa., one 50-horse power engine; The New Castle Steel company, New Castle, Pa., one 35-horse power engine; Trinidad Electric Light company, Trinidad, Colo., one 100-horse power engine; Edison Electric Illuminating company, Paterson, N. J., one 150-horse power engine; The Boulder Electric Light company, Boulder, Colo., one 100-horse power engine; Garden City Packing & Preserving company, Chicago, Ill., one 80-horse power engine; Paterson Electric Light company, Paterson, N. J., one 100-horse power engine; Gottfreid-Kreuger Brewing company, Newark, N. J., one 80-horse power engine; Ellensburg Electric Light company, Ellensburg, Wash., one 100-horse power engine; Jas. Hearn & Son, New York, N. Y., one 60-horse power engine; Bellingham Bay Improvement company, Sehome, Wash., one 80-horse power engine; Lebanon Electric Light company, Lebanon, Pa., one 100-horse power engine; Citizens' Electric Light company, Covington, Ky., one 100-horse power engine; Republican Publishing company, Denver, Colo., one 60-horse power engine; D. C. Spruance, Ballston Spa, N. Y., one 60-horse power engine; Athens Gas Light company, Athens, Ga., one 60-horse power engine; Buffalo Brewing company, Sacramento, Cal., one 35-horse power engine; Richardson Smith, Moore & Company, Snow Hill, Md., one 50-horse power engine; Edison Electric Illuminating company, Paterson, N. J., one 80 horse power engine; Poughkeepsie Electric Light company, Poughkeepsie, N. Y., one 100-horse power engine; Schuyler Electric Light company, Hudson, Mich., one 60-horse power engine; H. H. Brown, Denver, Colo., one 80-horse power engine; H. H. Brown, Canon City, Colo., one 60-horse power engine; Crook, Horner & Company, Baltimore, Md., one 35-horse power engine; Edison Electric Illuminating company, Brooklyn, N. Y., one 250-horse power engine; Reidsville Cotton Mill company, Reidsville, N. C., one 200-horse power engine; R. Mugge, Tampa, Fla., one 100-horse power engine; Norwalk & L. S., Norwalk Electric Light company, Norwalk, Ct., one 80-horse power engine.

Personal Mention.

John Hooper, a director in the Anglo-American Electric company, died at his home in New York city last week.

Robert T. Lozier of the Leonard & Izard company's staff of engineers, is in New York on a business and pleasure trip.

Electrical Patents.

Issued Dec. 24, 1889.

417,742. Electric Cam. Henry S. Prentiss, New York, N. Y.

By this invention a device fixed upon a shaft is caused to close the electric circuit but once during two revolutions of the shaft.

417,747. Device for Suspending Electric Conductors. Sidney H. Short, Cleveland, Ohio.

417,753. Time-Distributer for Electric Clocks. Louis H. Spellier, Philadelphia, Pa.

417,758. Automatic Circuit Closer. John von der Kammer, New York, N. Y.

417,763. Device for Demagnetizing Watches. Francis J. Whilton, Boston, Mass.

417,787. Incandescent-Lamp Socket. James W. Packard, New York, N. Y.

417,788. Incandescent-Lamp Socket. James W. Packard, New York, N. Y.

417,789. Incandescent Electric Lamp. James W. Packard, New York, N. Y.

This lamp is designed for high resistance circuits.

The second claim reads:

"In an incandescent electric lamp, the combination of the main bulb, together with the tubular portion or tip inserted and sealed in the end of the bulb, the inner end of said tubular portion being open, and one or more hooks on the inner end of said tubular portion."

417,794. Armature for Electric Machines. Albert Schmid, Allegheny, and Nikola Tesla, Pittsburg.

The core is composed of plates of magnetizable material separated by insulation; these plates are provided with diverging slots for receiving the armature conductors, and an opening to the exterior of the plate at the origin of the diverging slots.

417,814. Galvanic Battery. Patrick B. Delany, New York, N. Y.

417,842. Device for an Electric Car-Signal. John P. Runkel, Milwaukee, Wis.

417,920. Electric Heating Apparatus for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

Claim 1 reads:

"The combination of a suspended conductor, an electrically propelled vehicle, a current-collector extending from the vehicle to the suspended conductor, a secondary battery on said vehicle, an electric heater or stove to heat said vehicle, and a circuit including said battery and stove, and receiving current from the current collector."

417,923. Electro-Therapeutic Apparatus. Frederick J Kneuper, New York, N. Y.

417,926. Electric-Circuit Controller. Frederic A. Lane, New Haven, Conn.

This is an improvement on devices for limiting or controlling the time for which an electric circuit may be held broken or closed.

417,927. Automatic Electric Clock-Winding Device. Frederic A. Lane, New Haven, Conn.

417,928. Electric-Winding Clock. Frederic A. Lane, New Haven, Conn.

417,931. Magnetic Toy. George W. Miatt, Brooklyn, N. Y.

417,938. Vehicle Motor-Gear. Edgar Peckham, New York, N. Y.

417,974. Electric Railway Contact. Francis O. Blackwell, New York, N. Y.

The invention consists in providing a rod or arm extending upwardly from the car with a transverse slide at its lower end, permitting it to move from side to side of the car, as the irregularities in the supply wire may necessitate.

417,992. Underground Electric Conduit. John Dell, St. Louis, Mo.

The conduit has a central passage polygonal in transverse section, with radial partitions extending from the angles of the central passages to the outer wall of the conduit, forming an annular series of passages surrounding the central passage.

417,998. Trolley. William L. Emmet, Wichita, Kan.

Claim 1 reads:

"The combination, with the fixed plates, of a tube held between said plates, and a contact roller on said tube independent of the plates, and free to revolve on the tube."

418,041. Magnetic Rubber-Stock Cleaner. Nathaniel C. Mitchell, Philadelphia, Pa.

The second claim follows:

"The combination, with a series of magnetic separators arranged for successive action upon the stock, said separators being inclosed in a casing, of a pipe having its mouth overhanging the separators, and an air-exhausting device in said pipe."

418,069. Electrical Toy. Henry G. Rogers, Washington, D. C.

418,070. Electrical Toy. Henry G. Rogers and Andrew M. Coyle, Washington, D. C.

418,071. Automatic Vending Machine. Henry G. Rogers, Washington, D. C.

418,120. Magneto-Electric Machine. Webster Gillett, New York, N. Y.

418,125. Electric Synchronizing Device for Clock-Pendulums. James Hamblet, Brooklyn, N. Y.

418,140. Electrode for Secondary Batteries. Harry G. Osburn, Chicago, Ill.

A plate or grid is so constructed that, after the plastic active material is forced into the perforations of said plate or grid, and the latter completed and dried, the material is held securely therein.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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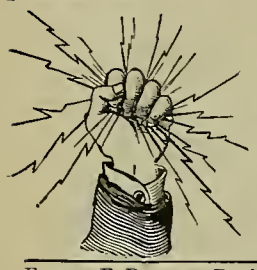

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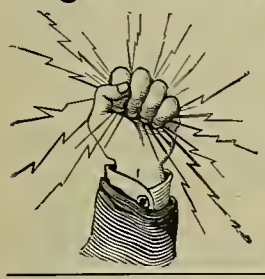

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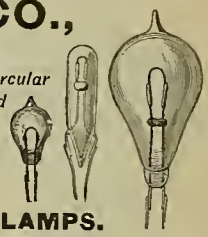

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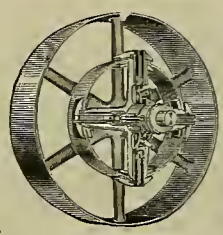

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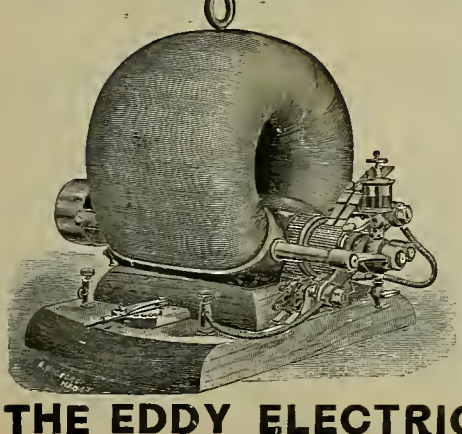

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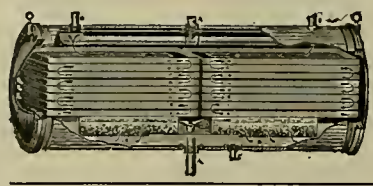

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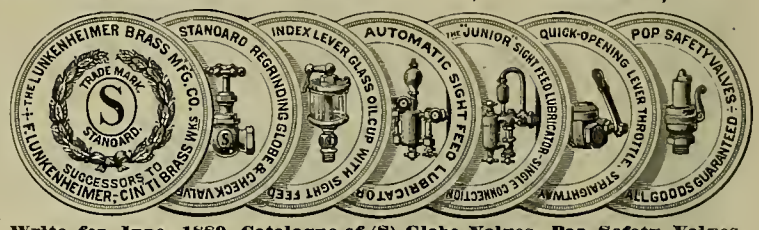

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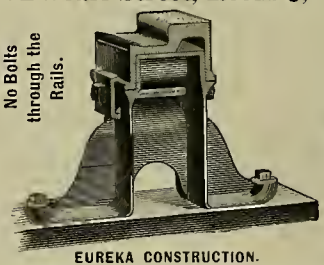

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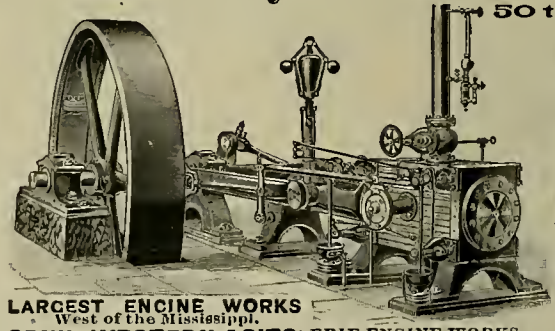

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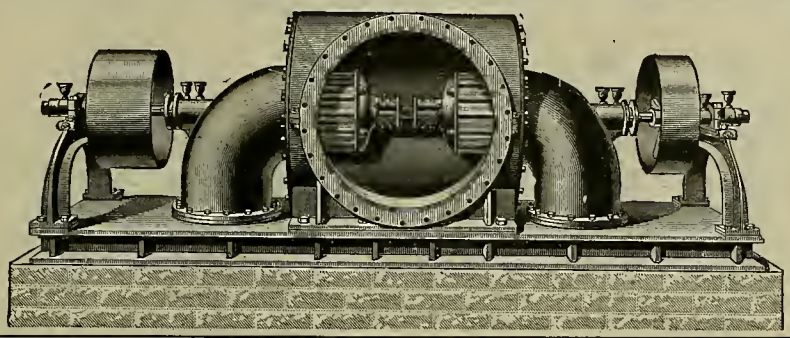

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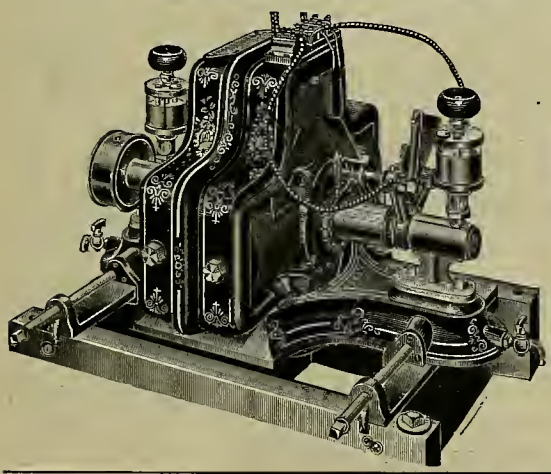

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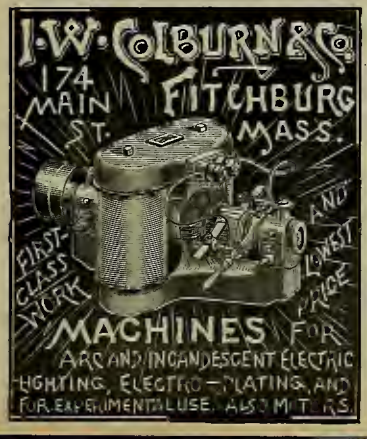

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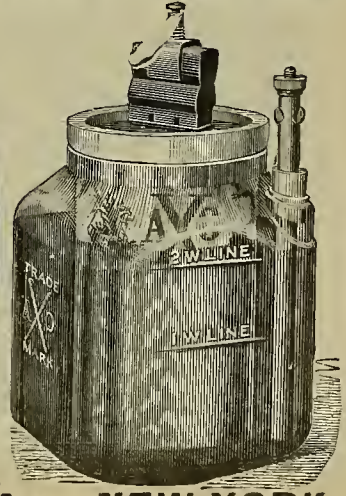

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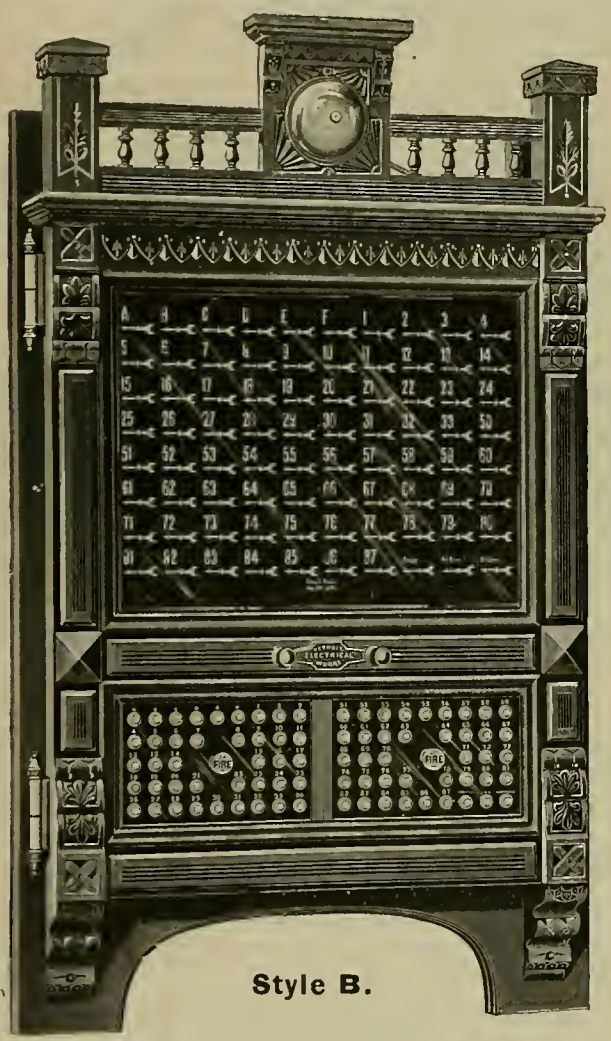

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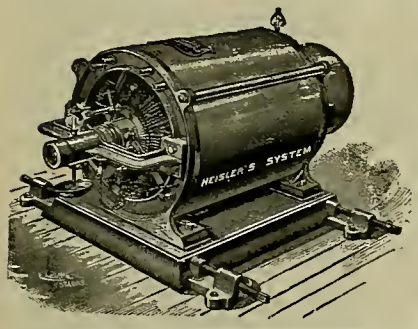

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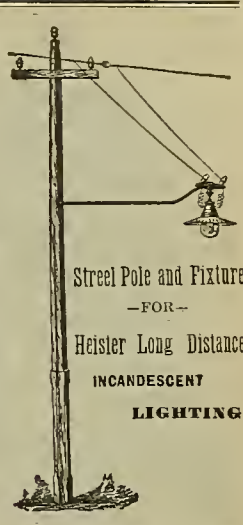

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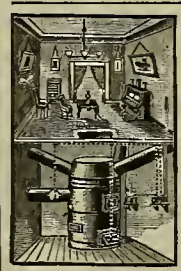

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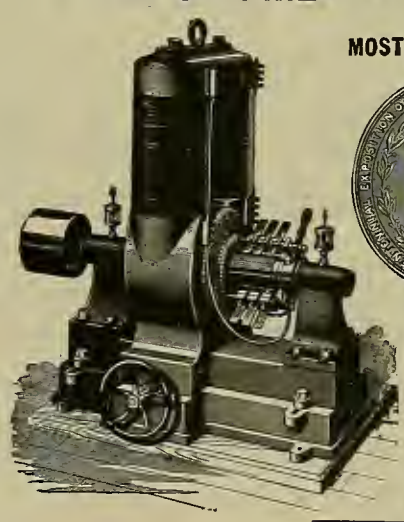

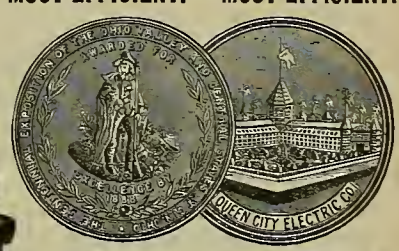

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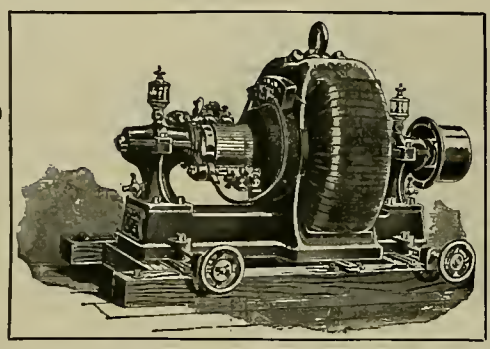

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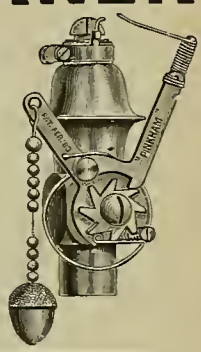

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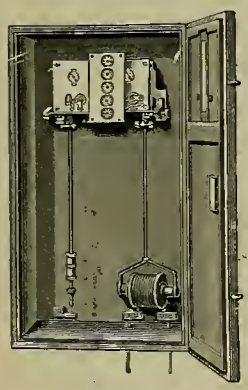

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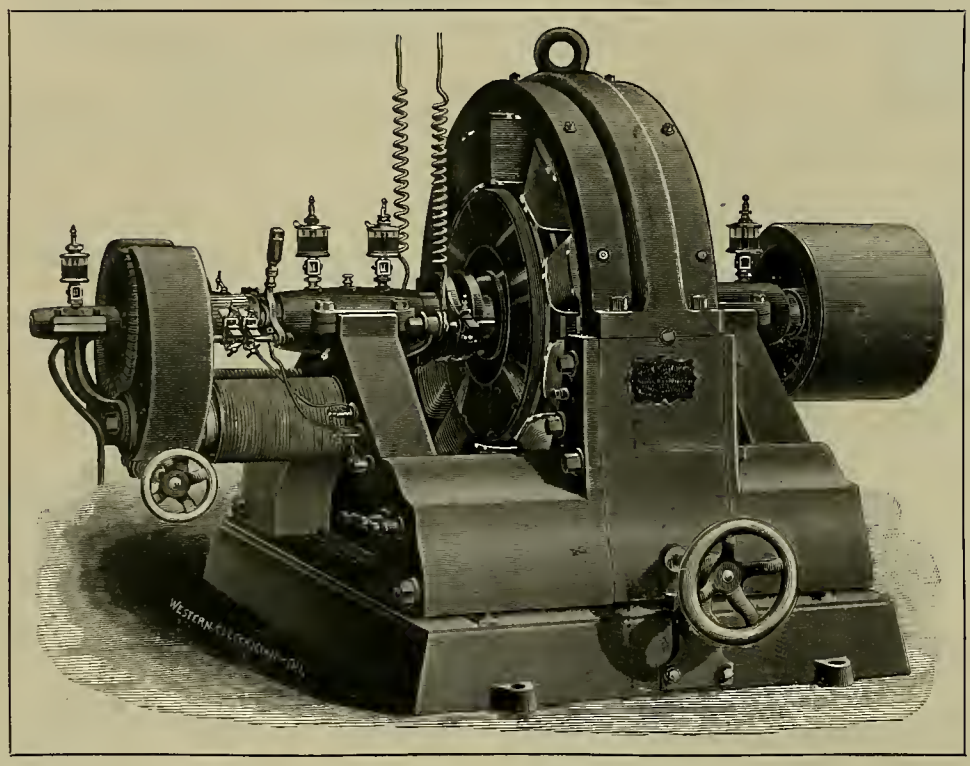

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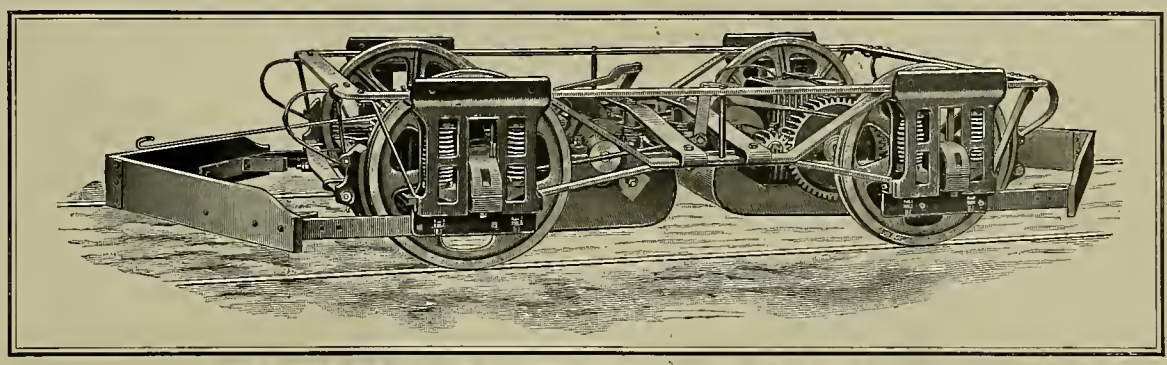

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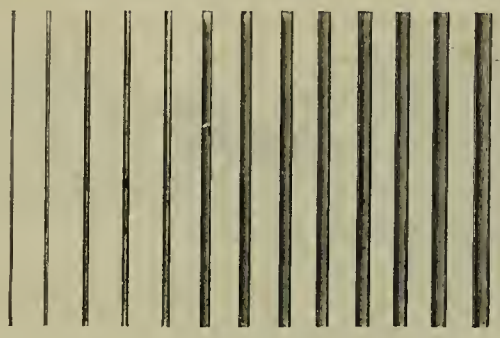

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1300	½	1.8	2.2	0	0	1	0	$1.90
1301	1	2	2.5	1	1	2	1	1.90
1302	2	4	4.4	2	2	4	2	2.40
1302½	2½	5	5.5	2	3	5	3	2.05
1303	3	5.4	6.2	3	4	6	4	2.10
1304	4	7	8	4	5	8	5	2.25
1305	5	8.3	10	5	6	10	6	2.60
1306	6	10	12	6	7	12	8	3 00
1307	7	11	14	7	9	14	9	3.50
1308	8	12	15	8	10	16	10	4.00
1309	9	13.5	17	9	11	18	12	4.50
1310	10	15	18.5	10	12	20	13	5.00
1312	12	18	21	12	15	24	16	6.00
1314	14	21	24	14	17	28	19	7.00
1315	15	22.5	27	15	18	30	20	7.50
1316	16	24	29	16	20	32	22	8 00
1318	18	26.5	30	18	22	36	24	9.00
1320	20	29	32	20	25	40	27	10.00
1325	25	35	40	25	31	50	33	12.00
1330	30	42	48	30	37	60	40	14.00
1335	35	49	56	35	43	70	46	16.00
1340	40	56	64	40	49	80	53	18.00
1350	50	68	76	50	62	100	67	19.00
1360	60	80	90	60	74	120	80	20 00
1370	70	88	105	70	86	140	93	21.00
1375	75	100	112	75	103	150	100	21.50
1400	100	120	140	100	122	200	133	24.50
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The broad right to the use of Double Carbon Electric Arc Lamps declared to belong to the Brush Electric Company, under U. S. Letters Patent to Charles F. Brush, No. 219,208.

In the suit of The Brush Electric Company vs. The Fort Wayne Electric Light Company, decided at Indianapolis, Dec. 24th, 1889.

JUDGE CRESHAM HOLDS:

1. *That Brush was the Pioneer Inventor in Commercial Arc Lighting.*
2. *That the Brush Patent in suit is the Pioneeer Patent for Double Carbon Arc Lamps.*
3. *That the Patent is Broad and Fundamental.*
4. *That all its Claims (six in number) are valid.*
5. *That the claims of the Patent are all infringed by the Defendant.*

The Court says: "The separation of the two pair of Carbons, so that the Arc is established between one pair and maintained between the Carbons of that pair until they have been consumed and then automatically established between the Carbons oi the other pair and maintained between them until they have been consumed is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the Lamp in suit from all prior lamps."

The Brush Eiectric Light Company is assured by the most competent legal advisers that under this Brush Patent, as interpreted by the U. S. Circuit Court, practically all Double Carbon Electric Arc Lamps now offered for sale are

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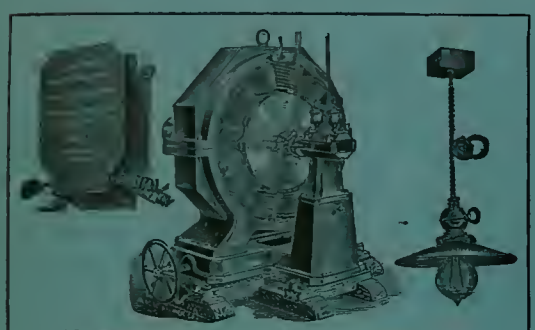

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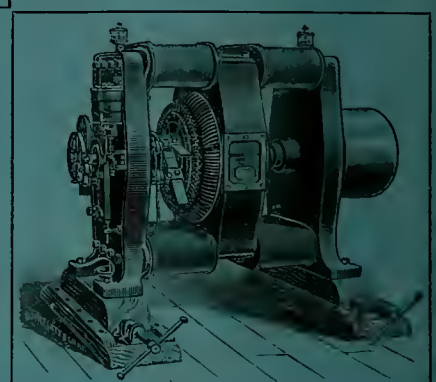

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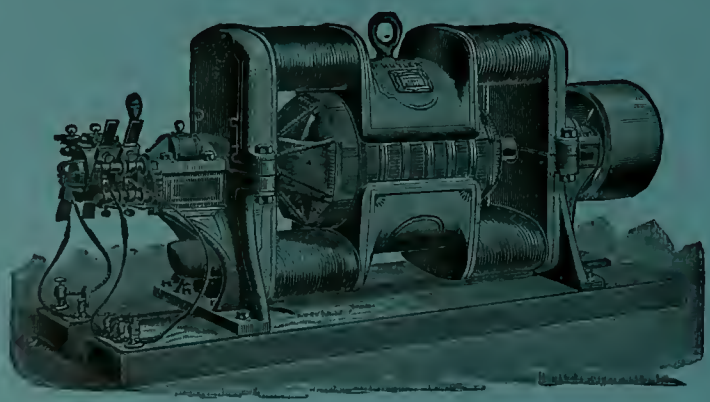

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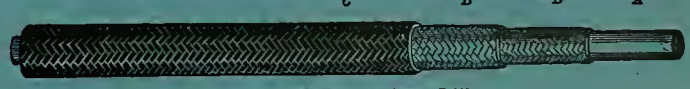

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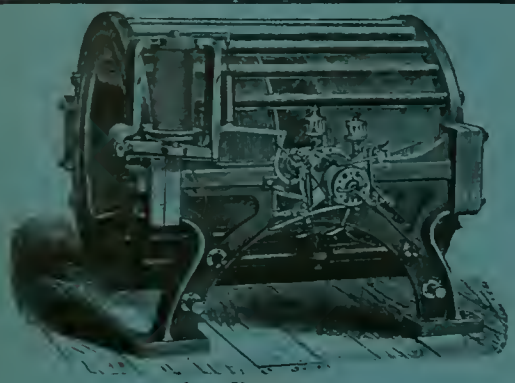

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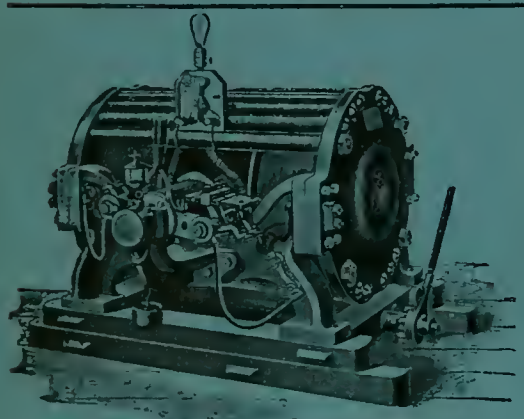

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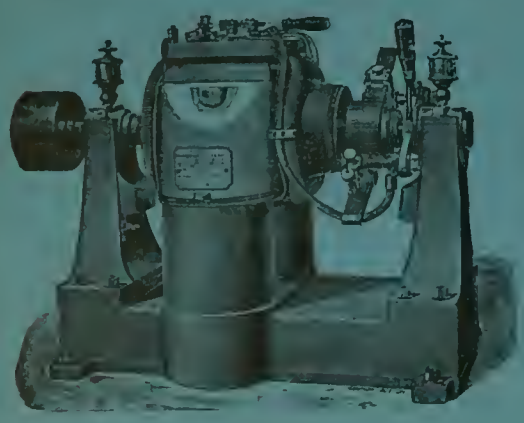

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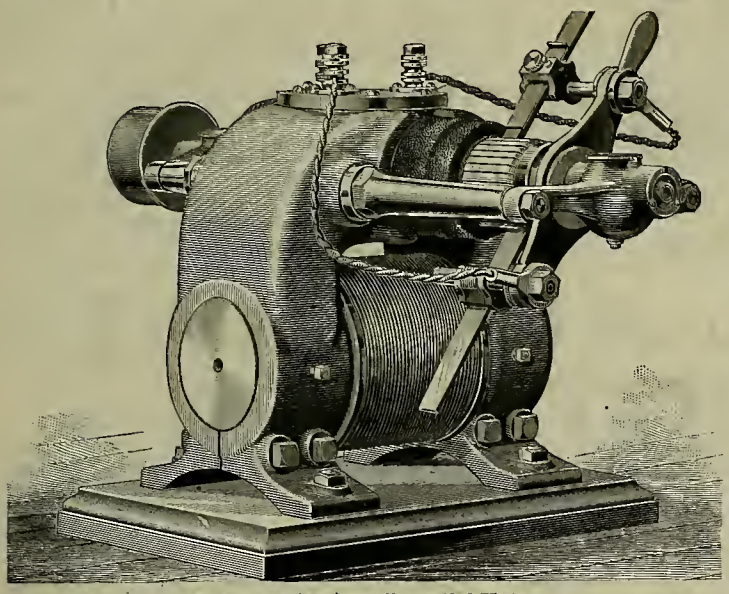

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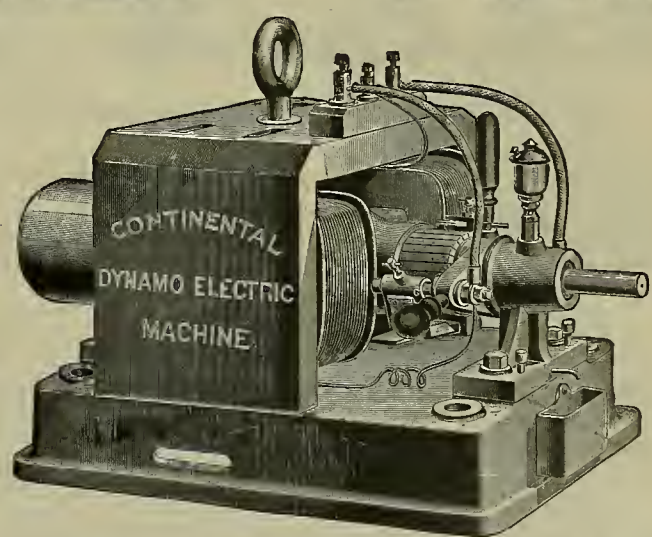

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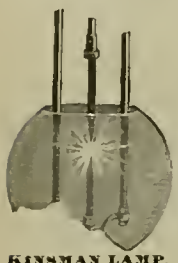

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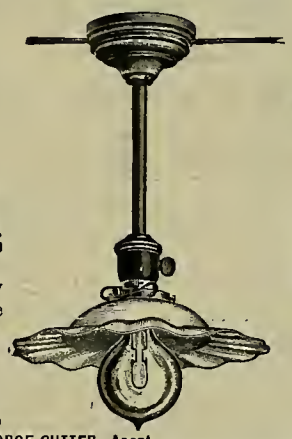

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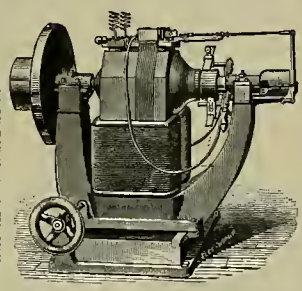

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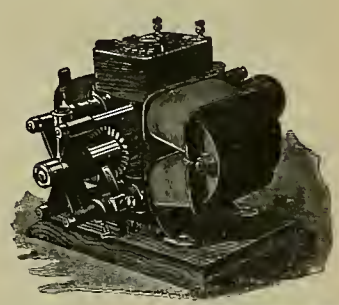

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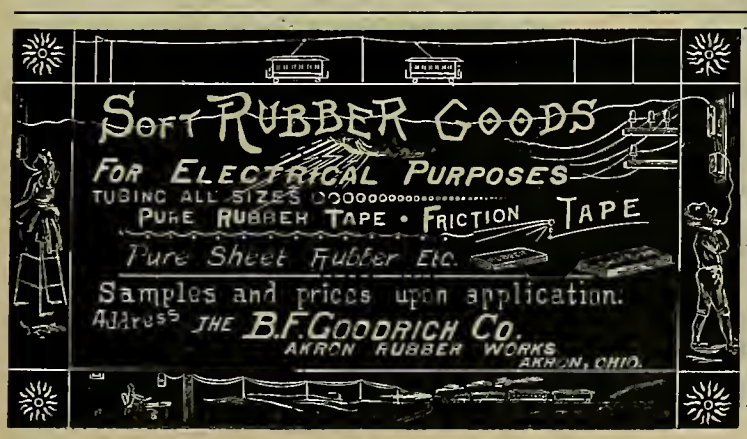

THE BEGINNING OF THE END.

EDISON COMPANY SUSTAINED.

WESTINGHOUSE COMPANY DEFEATED.

Sawyer-Man Patent Decided by the Court to be a Fraud and Absolutely Valueless.

EXTRACTS FROM THE DECISION OF JUSTICE BRADLEY, OCTOBER 5, 1889.

Circuit Court of the United States,
For the Western District of Pennsylvania.

THE CONSOLIDATED ELECTRIC LIGHT COMPANY (Westinghouse Company),

VS.

McKEESPORT LIGHT COMPANY (Edison Company)

No. 5 May Term, 1888.

ON BILL AND FINAL HEARING.

OPINION OF THE COURT.

BRADLEY, Circuit Justice:

....."The great question in this suit is, whether the patent sued on is valid, so far as involves a general claim for the use in electric lamps of incandescing carbon conductors, made of fibrous or textile substances. If it is, the complainant must prevail. If it is not, the bill 'must be dismissed.' "

....."Is the patent valid for such a broad claim? The defendants contend that it is not. First, because no such invention was set forth in the original application, but was introduced more than four years after it was filed, and after the same material had been used by Edison and claimed by him in application for a patent. Secondly, because Edison, and not Sawyer-Man, was really the original and first inventor of an incandescent conductor made of fibrous or textile material for an electric lamp."

....."It is very clear to us that in the original application for the patent sued on, the applicants had no such object in view as that of claiming all carbon made from fibrous and textile substances as a conductor for an incandescing electric lamp. Nothing on which to base any such claim is disclosed in the original application; we have carefully compared it with the amended application on which the patent was issued, and are fully satisfied that after Edison's inventions on this subject had been published to the world there was an entire change of base on the part of Sawyer & Man, and that the application was amended to give it an entirely different direction and purpose from what it had in its original form."

....."By an adroit amendment made in 1885, they say, 'Our improvement relates more especially to the incandescing conductor, **its substance**, its form, and its combination with the other elements composing the lamp.' The purpose of this amendment is obvious and needs no comment."

....."The fact is that Sawyer & Man were unconscious that the arc was not new, and supposed that they could get a patent for it; but as their eyes were opened, they changed about and amended their application, and made the material of the conductor the great object — carbon made from fibrous and textile material. Compare the original with the amended application, as first stated in this opinion, and this purpose most obviously appears."

....."The fact that the whole object of the application was changed, is evinced by the correspondence of the parties."

....."This testimony of Mr. Broadnax, which is undoubtedly to be relied on, in connection with the letter just quoted, shows that the idea of claiming carbons made from fibrous and textile materials was an after-thought, and was no part of the purpose of the original application. The amendments relating to this new and broad claim were made afterwards, in February and March, 1885.

"We are of the opinion that the changes made in the application in this regard were not justifiable, and that the claim in question cannot be sustained."

....."We are not at all satisfied that **Sawyer & Man** ever made and reduced to practical operation any such invention as is set forth and claimed in the patent in suit. Their principal experiments were made in 1878, and perhaps the beginning of 1879. The evidence as to what they accomplished in the construction of electric lamps is so contradictory and suspicious that we can with difficulty give credence to the conclusions sought to be drawn from it. **We are not satisfied that they ever produced an electric lamp with a burner of carbon made from fibrous material or any other material which was a success."**

....."**The application for the patent in suit was not made until January, 1880, nearly or quite a year after all their experiments had ceased, and after the inventions of Edison had been published to the world."**

....."**The explanations made by the complainants for the delay in applying for the patent in suit, fail to satisfy our minds that Sawyer & Man, or their assignees for them, have not sought to obtain a patent to which they were not legitimately entitled.**

"But suppose it to be true, as the supposed inventors and some of the other witnesses testify, that they did in 1878, construct some lamps with burners of carbon made of fibrous material and of an arched shape, which continued to give light for days or weeks, or months; still, were they a successful invention? Would any one purchase or touch them now? Did they not lack an essential ingredient which was necessary to their adoption and use? Did they go any further in principle, if they did in degree, than did other lamps which had been constructed before? It seems to us that they were following a wrong principle—the principle of small resistance in an incandescing conductor, and a strong current of electricity; and that **the great discovery in the art was that of adopting high resistance in the conductor with a small illuminating surface and a corresponding diminution in the strength of the current. This was accomplished by Edison in his filamental thread like conductors, rendered practicable by the perfection of the vacuum in the globe of the lamp.** He abandoned the old method of making the globe in separate pieces, cemented together, and adopted a globe of one entire piece of glass, into which he introduced small platinum conductors, fastened by fusion of the glass around them, thus being able to procure and maintain perhaps the most perfect vacuum known in the arts. In such a vacuum the slender filaments of carbon attenuated to the last degree of fineness, may be maintained in a state of incandescence without deterioration, for an indefinite time, and with a small expenditure of electric force. **This was really the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purposes of general use in houses and cities."**

....."**The principal and great thing described is the attenuated filament, and its inclosure in a perfect vacuum."**

....."**We think we are not mistaken in saying that but for this discovery electric lighting would never have become a fact. We have supposed it to be the discovery of Edison, because he has a patent for it. This may not be the case; it may be the discovery of some other person. But whoever discovered it, it is undoubtedly the great discovery in the art of practical lighting by electricity."**

....."**The bill must be dismissed."**

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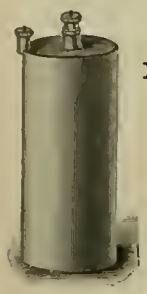

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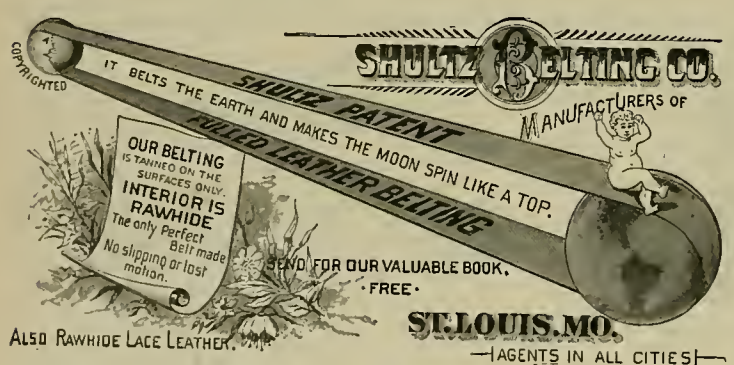

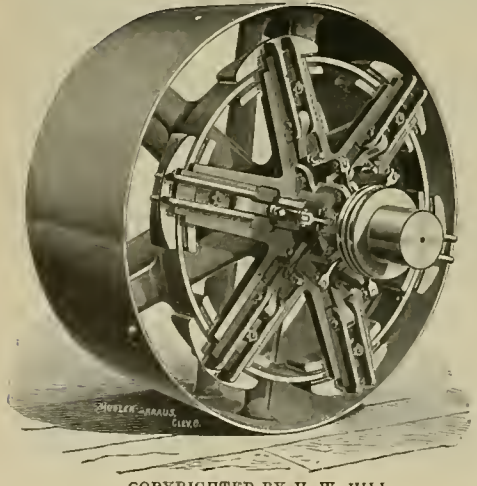

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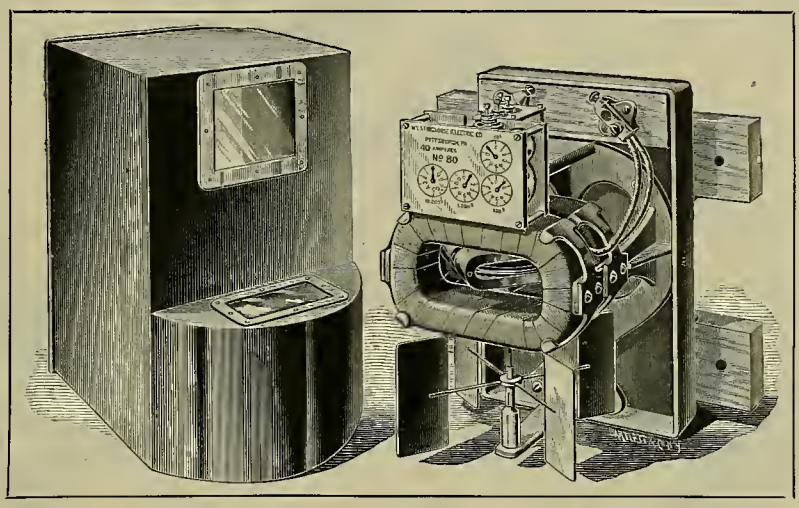

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Vol. VI. CHICAGO, JANUARY 11, 1890. No. 2

The Brush Station at Rochester, N. Y.

The accompanying cut illustrates the new dynamo room of the Brush Electric Light company at Rochester, N. Y. It is situated at the lower falls of the Genesee River and is operated by water power. Fifteen Lessner turbines under 88½ feet head, operate the dynamos. There is also in the station a 650-horse power Cooper-Corliss engine but this is intended for use in case of the failure of the water supply.

The company at present is operating twenty-nine dynamos, supplying current for 1,300 arc, 104 Bernstein, 200 Brush-Swan lamps, and 400 motors. It has 330 miles of wire, all overhead. The motor service has assumed considerable importance in Rochester. The Brush company supplies current to 89 tailor shops that are operated entirely by motors, 9 printing offices, 2 machine shops, 3 shoe shops, 2 laundries, 2 necktie factories, 2 horse collar factories. Seven dental establishments utilize electricity, and coffee and spice mills, elevators and ventilating fans without number are operated by electric motors.

The general favor with which electric light and power has been received in Rochester and the remarkable development of electrical interests there is due to the excellent service and reasonable rates of the local companies. The Brush company, which was established in 1881, was a pioneer in the field. It started in with 16 lights in 1881. At that time a 50-horse power engine was used, but this was only a temporary arrangement, and soon the excellent water power of the Genesee was utilized. Numerous extensions have been made and the present station of the company has a capacity of 3,000-horse power. This is one of the largest stations in the country operated by water.

George A. Redman, superintendent of the company, states that the construction work of the Brush company in Rochester, cannot be excelled. In support of this claim it may be said that during a recent wind storm in that city a huge flag pole was blown down and in falling struck the company's wires, but did not damage them. The force of the blow, however, was so great that the pole was broken where it struck the wires.

BRUSH STATION AT ROCHESTER, N. Y.

The electric and gas companies of Fremont, Ohio, have been consolidated and are now under the management of the Electric Light company of that place.

Fire in an Edison Station, New York.

The Pearl street station of the Edison Illuminating company in New York city was destroyed by fire on January 2d. The fire started at about 6 o'clock in the morning in the dynamo room. Nobody knows how the fire originated, for when it was discovered the oil-soaked floors of the old building were ablaze.

The station contained 8 "Jumbo" dynamos with engines and boilers necessary to operate them. It furnished current for 18,000 incandescent lamps in many of the most important commercial buildings in the city. The station was entirely destroyed, the loss being estimated at $200,000.

The Pearl street station was the first in the country from which current was distributed through underground service. The building was an old rickety warehouse, and was not built for a central station. As the demand for light increased, additional room was secured by annexing smaller buildings of the same character as the original structure.

Temporary arrangements were made to supply lights to consumers until the company can build a new station.

A New Toy Motor.

At this time, when so much is being written and said about the electric railway and the stationary motor, there are many who naturally feel some curiosity to learn of the manner in which the current is applied to produce the various effects. The little motor shown in the accompanying cut was designed to illustrate the conversion of electricity into power. An idea of its size may be obtained by a comparison with the tumbler which constitutes the battery jar. The motor is very compact; it is only about 4 inches high. The fly-wheel is 2 inches in diameter and

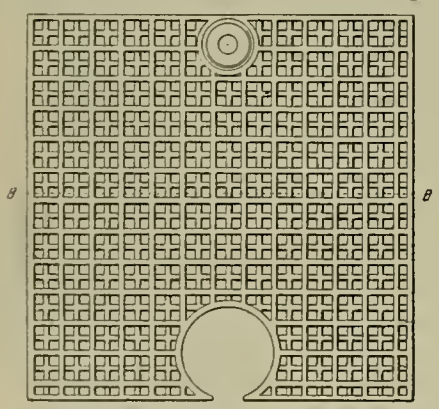
NEW TOY MOTOR.

makes about 500 revolutions per minute. The elements of the battery are held in any ordinary tumbler.

As shown in the cut, the little engine is belted to a music box. It may be mentioned in this connection that the Beckwith Manufacturing company, Chicago, which is introducing this novelty, has received a number of amusing letters in regard to the "engine." One inquiry was as follows: "Please has the small motor power enough for to keep a Small windmill or pump a-going, pumping water away from a well which overflows?"

New Plate for Secondary Batteries.

One of the greatest difficulties met with in the construction and use of secondary batteries is the retention of the active material in the grids



NEW PLATE FOR SECONDARY BATTERIES.

or plates. This active material while in a plastic state, is pressed into the spaces in the grids. These, after the paste has dried, are placed in the solution. Now when the charging and discharging takes place, or when the batteries are subjected to any considerable jolting or jarring as would be the case in street car work, the material in the plates is liable to wash out, or fall out, of the perforations of the plates, thus very materially affecting the efficiency of the battery.

The grid illustrated in the accompanying cut was designed to overcome this difficulty. In order to understand the construction of the plate it will be necessary to refer to the sectional view, together with the view just above it. This section is on the line, B B. At first sight it would appear as though the plate was composed of two grids so placed in relation to each other that the openings in one coincide with the points of intersection of the ribs in the other—as is shown in the upper figure. Instead, however, of two plates arranged as described, the grid is cast in one piece. By this peculiar construction, when the active material has been pressed into the plate on both sides, each little block or square of paste is, as it were, locked in place by being united with the corners of four of the blocks on the opposite side of the grid. In order to provide additional precautions against the active material becoming dislodged from the plate, the outer surfaces or crest of the ribs in the grid are formed with V-shaped gutters in them. This construction, which is shown more clearly to the left in the lower cut, makes what might be described as "marginal fins" for each square inclosure. After the grid has been filled with the plastic material it is then subjected to such treatment, either by hand or machinery, that the fins formed by guttering the ribs are upset, as indicated in the sectional cut, over the walls of the square inclosures. The blocks of paste are thus made doubly secure. This grid is the invention of H. G. Osburn, of the Pumpelly Storage Battery & Electric Motor company, Chicago.

New Arc Lamp.

The accompanying cut represents diagrammatically the general arrangement of parts and the connections in a novel and simple arc lamp, which has recently been invented by J. H. Bunnell of New York.

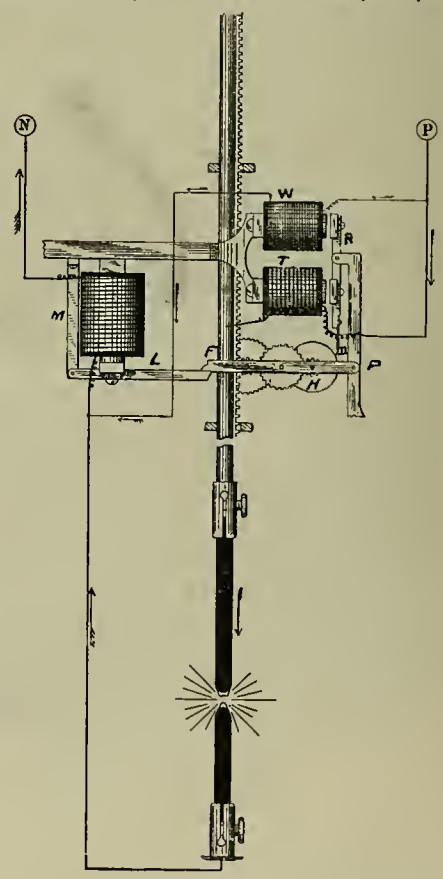
In the cut, in order to simplify the description, the essential parts of the lamp are shown without all the necessary framing and supports for the several portions. It will be readily seen that the lamp is of the type in which the positive or upper carbon is fed downwardly by gravity. The lamp was designed with the view of making the arc-forming mechanism practically independent of the feeding mechanism—that is to say, the feeding mechanism will operate to allow the downward movement of the positive carbon without affecting the mechanism which has been used for constructing the arc.

Referring to the cut the parts may be described as follows: *M* is an electro-magnet of the ordinary form which acts upon a bar armature attached to the lever *L*. The lever *L* is pivoted as shown and adapted, upon attraction, to lift the free end of the frame, *F*, for the purpose of drawing the arc. The magnet *M* carries the main current. The frame *F*, which rests on the end of lever *L* and is pivoted at *P*, carries a train of gearing. The slow speed member of the train meshes with the rack on the carbon rod, while the high-speed member, *H*, engages as shown with a detent, *D*. This detent, or brake, is attached to the end of the pivoted lever, *R*, which also carries two armatures. The magnets *W* and *T* are set as shown in relation to the armatures on the pivoted lever.

The electrical connections which may be readily traced out are as follows: *N* and *P* represent the binding post of the lamp. The magnet *T* is connected in the main circuit; magnet *W* is in shunt to the arc, and the magnet *T*; magnet *M* is in the main circuit outside the other connections.

On the admission of current to the lamp the actions are as follows: The carbons being in contact, practically no current flows through the shunt-magnet *W*. Current through magnet *T* attracts the lower armature and locks the train of gearing. Current passing through magnet *M* powerfully draws lever *L*, lifts the frame *F* and its train of gearing, and thus lifts the carbon-rod and the positive carbon to the full extent to which the lamp is adjusted—say one-eighth of an inch. This attractive movement of the armature attached to *L* is once for all, as it remains in an attracted position so long as current flows through the lamp. The frame *F*, therefore, is rigidly held in a stationary position. On the establishment of the arc its resistance causes the flow of a proportionate amount of current through the shunt-magnet *W*, and the latter will begin to attract the upper armature, not, however, with sufficient power to overcome the attraction of magnet *T* for its armature. The adjustment, however, is such that the slightest increase of current through the magnet *W*, together with the slight reduction of current through magnet *T*, will cause the attraction of magnet *W* to preponderate to a sufficient extent to release the brake *D* from the wheel, and permit the latter to rotate under the propelling force of the weight of the rod and its carbon. The latter at once feeds downwardly, but is immediately checked by the weakening of magnet *W*, due to this shortening of the arc. The wheel *H* is again immediately locked and remains so until a further feed is necessary. While the operation of feeding has been described as being, so to speak, intermittent, or step by step, it is obvious that the action of the mechanism can be made remarkably delicate.

A noticeable feature in the lamp is the absence of dash-pots or other retarding mechanism. In a lamp constructed on these principles,



NEW ARC LAMP.

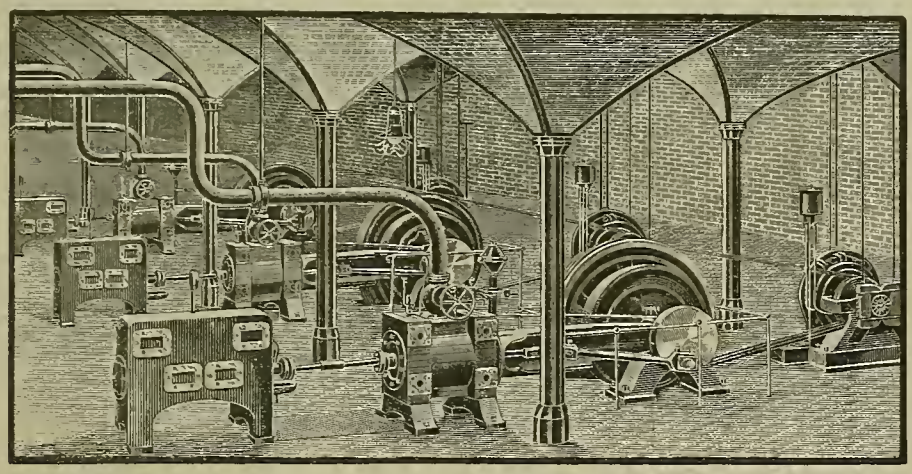
it is claimed, there is no tendency to "pumping," and no possibility of the variations of current in the main line causing a chattering of the feed or oscillation of the arc-forming mechanism.

Electric lighting in Indianapolis, Ind., is growing in popular favor. Last year 100 lamps were introduced for street lighting, and this number will be largely increased this year.

The First Central Station in Paris.

In a previous issue of the WESTERN ELECTRICIAN a plan of the central station at the Halles Centrales in Paris was presented. The accompanying cut shows a view of the interior of this same plant, which is the first central station in Paris.

All the machinery is located in the basement of the Halles Centrales. The engine and dynamo room occupies 2,000 square yards, and the



FIRST CENTRAL STATION IN PARIS.

boilers 350. There is also a large coke yard, stores, workshops and offices. Six Belleville boilers are used. There are three triple-expansion vertical engines by Weyher & Richemond, giving 140 horse power at 160 revolutions, and three single cylinder engines by Lecouteux and Garnier, of 170 horse power with Corliss valve gear. Each of the last works a Ferranti machine, giving 2,400 volts and 50 amperes, at 500 revolutions. Each of the Weyher & Richemond engines drives two Edison machines of the latest type, which are connected on the three wire system. Fifteen volts total drop in the feeders is allowed, and two volts on the most remote lamps, so that the pressure is practically constant. The farthest lamps are 1,000 yards from the station. The largest feeder is only a quarter of a square inch in section. Provision is made for from 1,500 to 2,000 60 watt lamps. The cables are carried in cement culverts built in the street. Every five feet there is a wooden frame built in, which carries a number of enameled iron hooks. Each hook carries one cable. The alternate current plant is intended to supply the private consumers in the Petits Champs, the Avenue de l'Opera, and the Boulevard de la Madeleine.

Telegraph Superintendent Compelled to Testify.

Frederick H. Tubbs, superintendent of the Western Union Telegraph company, Chicago, appeared before Judge Tuthill last week, in answer to a citation to show cause why he did not reply to certain questions before the Chicago commissioners appointed by a Kansas City court to take evidence in a suit by Edward L. Randall, against the Chicago, Rock Island & Pacific railway company.

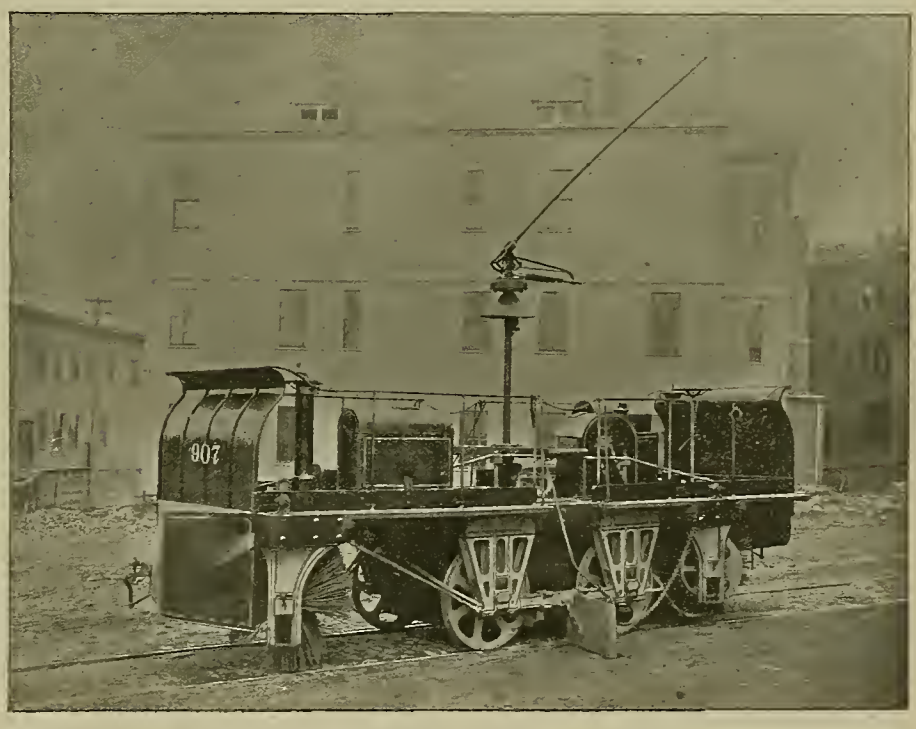
Randall sued the railway for $25,000 damages in Kansas City for alleged malicious persecution. He was a telegraph operator for the road at Davenport, Ia., but was discharged July 21, 1886, as he asserts, for participating actively in the organization of a branch of the Order of Railway Telegraph Operators. Superintendent Swift, of the Rock Island, it is charged, sent a secret circular to all telegraph offices in the country blacklisting him, and when Randall came to Chicago and applied to Tubbs for work, it was refused him.

Mr. Tubbs was cited before the commissioners to testify as to whether he received the circular of Swift, and if so, whether it determined him in his refusal to employ Randall. Mr. Tubbs answered some of the questions frankly, but there were others as to matters of which he exhibited dense ignorance. Randall's attorney reported to Judge Tuthill that there was a list of questions which he either declined to answer altogether or to which he returned evasive replies. Mr. Tubbs was represented by counsel, who argued that the questions to which Randall desired answers were questions of privilege, and being between two officials in confidence could not be construed as a public denunciation of Randall. Randall's lawyer contended that the effect was the same, since Swift's circular was a constructive charge of unfitness, and prevented Randall from getting work.

Judge Tuthill thought that inasmuch as Randall was not an employe of the Western Union Telegraph company, it was stretching it a great deal to apply the rule of privileged communication because he might at some time become an employe. The court ruled that Mr. Tubbs must answer the question, or be attached and punished.

Electric Sweeper.

The cut presented herewith shows the general construction of the new electric sweepers which were recently for the first time put to a practical test on the West End road in Boston. They were designed by Louis Pfingst, the master mechanic of the West End road. Three of them have been furnished, and four more are being built. They consist of a platform car mounted on a four-wheel truck, two Thomson-Houston motors being connected with the axles. Underneath each end of the car is a large cylindrical brush made of rattan, set horizontally at an angle of about 45 degrees, and reaching across the track. The brushes are revolved very rapidly by a 15 horse power electric motor which is on the platform of the car. The sweepers are propelled precisely the same as an electric car.



ELECTRIC SWEEPER.

In Boston there has been a good deal of interest to know how the electric street cars would behave in a genuine snowstorm. On the night of Saturday, December 14th, was the first opportunity for a practical demonstration, and the result was that it appeared to make little difference whether the weather was fair or foul. Through all the falling snow the cars are said to have moved as steadily and as uninterruptedly as usual, and such brief delays as were met with were entirely on account of the inability of the four-horse cars to keep out of their way. That such was the case was largely due to the successful working of the sweepers. These were kept running as long as there was need. They worked even more effectively than had been anticipated, removing the snow so completely that the rails glistened brightly under the street lights. So far as the trolley wires were concerned, the storm offered no impediment to the running of cars. Even on up grades with a second car in tow, both heavily loaded, they could move along, stop and start again, which four horses could scarcely do with one half-filled car. When the sweepers were started another generator was put in operation, although its use was not absolutely necessary. This gave the power to run thirty-five cars and the three sweepers, each of which was equal to about a car and a half. On the whole, it is stated that the experience of Saturday night demonstrated satisfactorily that the electric lines will be able to cope successfully with any snowstorm that may come along. For the cut we are indebted to the *Street Railway Journal.*

Railroad Arrangements for the Convention of the Electric Light Association.

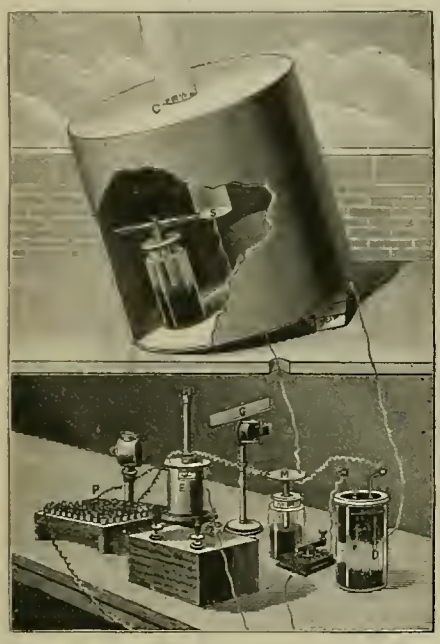
The Chicago transportation committee of the National Electric Light association, has selected the Chicago, Burlington & Quincy railroad as the official route for delegates starting from Chicago. The railroad company will take particular pains to furnish the very best of accommodations and no pains will be spared to administer to the comfort and pleasure of the electric light men. It is worthy of note also that the Eastern special train which comes to Chicago over the Pennsylvania road will go from Chicago to Kansas City over the Chicago, Burlington & Quincy, and it is probable that the Chicago cars will be attached to this train. The Burlington has a first-rate road bed and a thorough equipment throughout, and the committees have done well to select this road as the official route between Chicago and Kansas City.

Delegates should remember that a special rate

of a fare and a third has been arranged for, notwithstanding the fact that the service and time will equal that of the limited trains. Full information and bookings for berths can be secured by addressing W. W. King, city passenger agent, Chicago, Burlington & Quincy Railroad, Clark and Adams streets, Chicago.

Electric Phenomena Produced by Solar Radiations.

The following abstract of an article by A. Nodon, in *La Nature*, contains an account of several interesting experiments performed with a view of establishing the fact that solar radiations are the cause of certain electrical phenomena:



ELECTRIC PHENOMENA PRODUCED BY SOLAR RADIATIONS.

As a consequence of numerous observations made between May, 1885, and July, 1889, I have been enabled, writes Mr. Nodon, to establish the fact that solar radiations are the cause of certain electric phenomena, the study of which is summed up in the following laws:

1. Solar radiations, upon meeting with an insulated conductor (metal or carbon), communicate thereto a positive electric charge.

2. The extent of such charge increases with the intensity of the radiations and decreases with the hygrometric state of the air. At Paris, its value reaches maximum in summer at about one o'clock in the afternoon, when the atmosphere is pure and dry.

3. The passage of clouds near the sun causes the phenomena to cease.

The experimental arrangement adopted was as follows: A large metallic cylinder, *C* (see figure), turned toward the sun, was put in communication with the earth and formed a Faraday's cage. An aperture in the cover permitted the solar rays to enter the cylinder and strike a metallic plate, *S*, arranged in the center. This plate was of copper and had been carefully insulated upon Mascart's support. A conducting wire, wound with silk insulated with paraffine, was fixed to the plate, *S*, and ran to a room below, in which were arranged the observation apparatus. These latter were as follows: A Mascart electrometer, *E*, a 100 element battery, *P*, a standard Daniell element, *D*, a graduated scale, *G*, and a sulphuric acid insulating support, *M*.

The box, *C*, the box of the electrometer, *E*, the center of the battery, *P*, and the negative plate of the battery *D*, were connected at the same point of the earth, whose potential was taken as zero. The electrometer needle was connected with the insulated metallic plate.

I used in succession the Lippmann electrometer, which had to be abandoned on account of its too great capacity for this kind of experiments, the Hankel electrometer, and the Curie and the Mascart. The following is in what the experiment consisted:

The insulating support, *M*, to which were fixed the wires communicating respectively with the plate, *S*, and the electrometer needle, *E*, were so connected with the ground that the potential of the plate and needle became equal to that of the ground, which was taken as zero. The support was then insulated from the ground, and there was immediately observed upon the scale, *G*, a deflection of the needle indicating a *positive charge* of the plate, variable with the intensity of the solar radiations and the hygrometric state of the atmosphere.

This deflection was compared with that produced by the Daniell element, *D*, of which the positive pole was connected with the electrometer needle and the negative with the earth. Moreover, I had carefully studied, in some preliminary experiments, the influence of the complex phenomena that might vitiate the observations by producing an electric charge independent of that due to solar radiations. In this way I ascertained that by suppressing the Faraday cage, the metallic plate, being exposed to the free air and shade, became charged under the influence of the wind alone.

In the observations, this disturbing cause was carefully eliminated by the use of the metallic box, *C*, the presence of which prevented the wind from reaching the plate, *S*.

The other secondary phenomena, such as the heating of the plate, the thermo-electric actions, etc., were found to be of no consequence in the presence of the phenomenon studied. After this study of the phenomenon, let us endeavor to draw some practical consequences from it relative to the electrification of clouds. We must in the first place admit that these results may be extended to non-metallic bodies, such as the clouds. This is a simple though very probable hypothesis, but one that it will be necessary to verify the accuracy of.

When solar radiations traverse a pure and dry atmosphere, they charge the earth that they strike with positive electricity. By analogy with actino-electric phenomena we may admit that the stratum of air immediately in contact with the earth becomes charged with negative electricity. This air, heated by the sun, rises and carries with it its negative charge. This current of ascending air follows an oblique direction under the influence of the wind, and it often happens that, in its ascent, it meets clouds of more or less thickness, to which it abandons its negative charge.

This negative charge continuously increases under the influence of these masses of electrified and incessantly renewed air. This hypothesis would seem to give the explanation of a certain number of storm phenomena. It would appear to explain the negative charge of the majority of clouds. The positive charges that are sometimes observed in clouds may be explained by the supposition of two strata of clouds between which the electric manifestation may take place. Such charge of the clouds should be so much the greater in proportion as the solar rays are intenser, and the hygrometric state of the atmosphere feebler. And this is what should especially take place in summer and principally in equatorial regions. This would be explained by the frequency of storms during the hot season and during the summer days in which the solar rays are intense. Herein, too, should be found an explanation of the fierce storms which chiefly prevail in the equatorial regions.

Nocturnal storms would be due to clouds charged with electricity during the day under solar influence, and which would become discharged at night in consequence of the descent of the clouds toward the earth, the explosive distance then becoming sufficiently small to allow the discharge to take place between the cloud and the earth. Such descent of the clouds toward the earth at night is due to the cooling of the ascending currents of air which sustain the clouds in the atmosphere.

We might, in analogous manner, explain the frequency of storms over forests, rivers, lakes, etc., as a consequence of the lowering of the temperature of the air above such regions—a lowering that carries with it the descent of the storm cloud toward the earth.

Telephone Service in St. Louis.

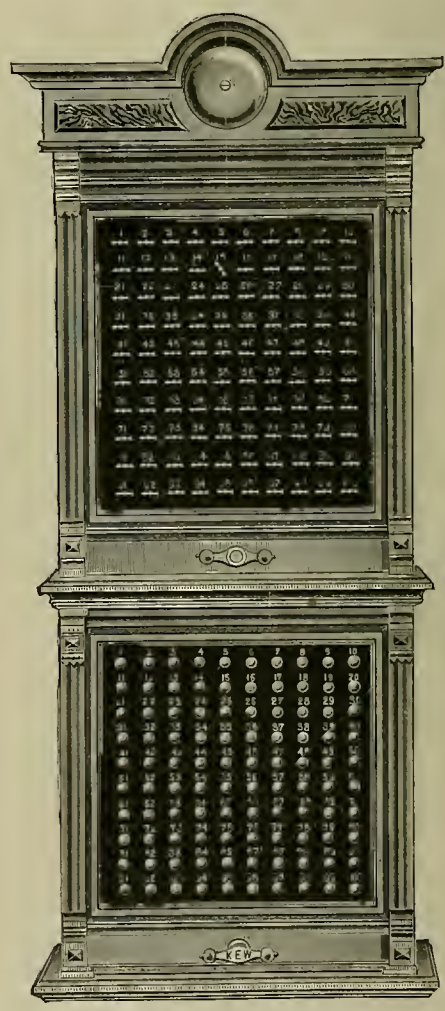
George F. Durant of the Bell Telephone company, St. Louis, said recently of the disturbances on the line caused by induction: "The only absolute remedy for us is to supply each subscriber with a metallic circuit. This we expect to when we put our wires underground. The existing plant has neither the capacity nor the conditions requisite for such a system. We are now, as a temporary expedient, running a number of common return wires to afford a metallic circuit, one side of which is common to a number of subscribers. We expect some relief from this, probably enough to enable us to operate the wires at night. Our ordinance, which is in the form of a consent by the city to our placing our wires underground, is in the hands of the Committee on Public Improvements of the Council, with some amendments suggested by the Board of Public Improvements, to whom it was referred by the committee."

Electrical Engineering in the Western University.

A chair of electrical engineering has been established in the Western University at Pittsburgh, Pa. Prof. C. V. Kerr will be the instructor. He is a graduate of the Western University and of Stevens Institute, and recently has had charge of the electrical department in Pratt Institute, New York. Work will be commenced in the new department at once.

Hotel Annunciator.

The accompanying cut illustrates an improved form of hotel annunciator manufactured by the



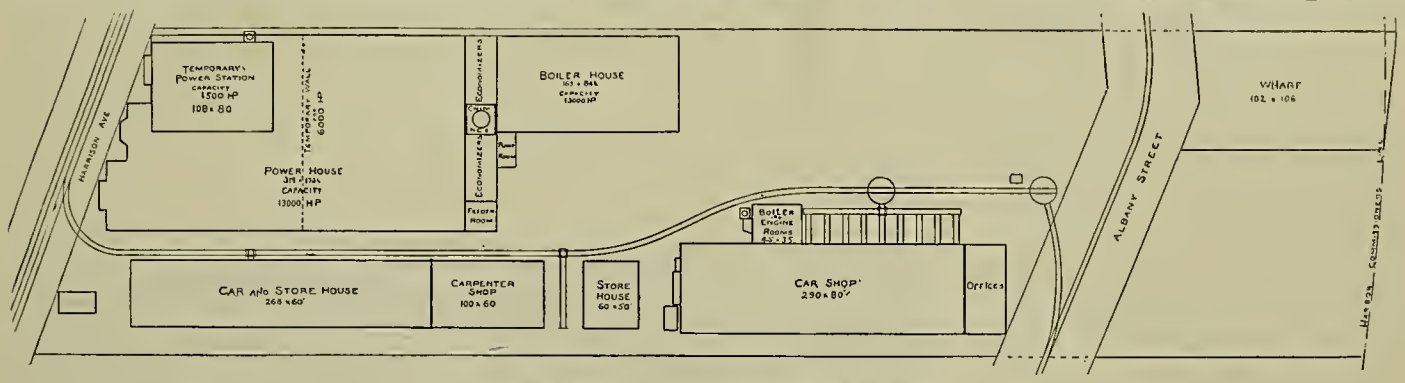
HOTEL ANNUNCIATOR.

Knapp Electrical Works of Chicago. It combines the office annunciator and drop, the return room call and fire alarm. Many excellent features in wiring, superior workmanship and the material used, make it highly desirable. Already a large number of these annunciators have been disposed of and in every case they have given satisfaction.

Oldtown, Maine, is to have an electric lighting plant in operation very soon. A representative of the Westinghouse Electric company closed an order at that place for a 750-light alternating current dynamo recently, and this machine will be shipped from Pittsburg immediately.

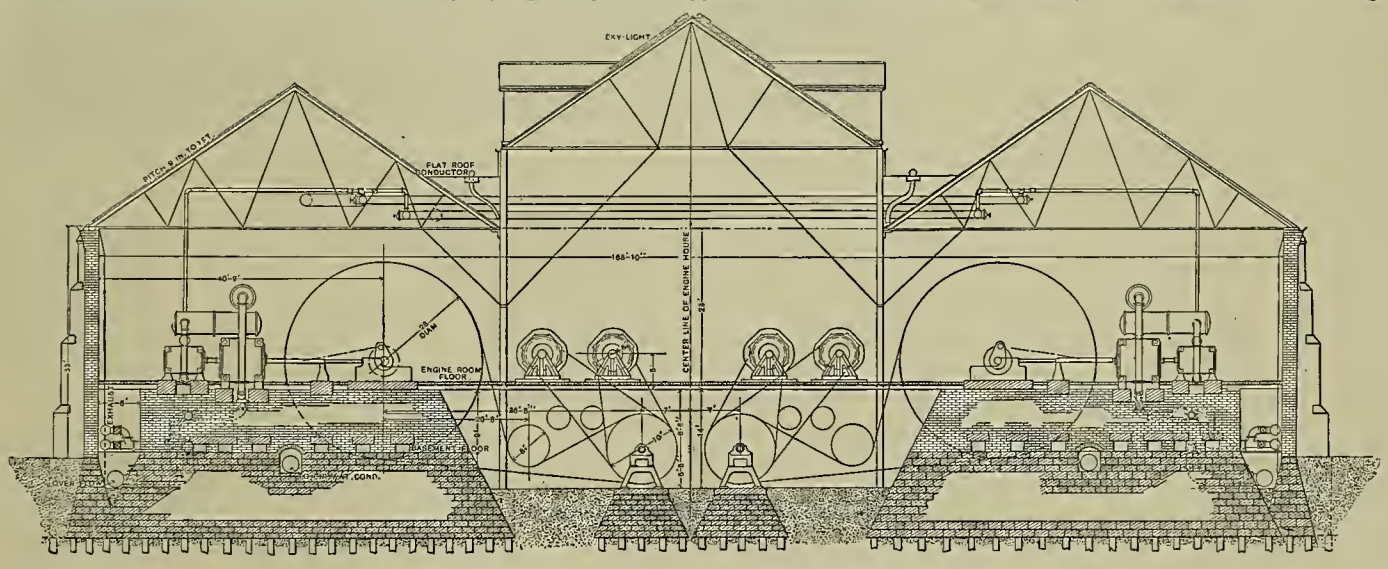
West End Railway Power Station at Boston.

The cuts presented herewith show the location and general arrangement of the new permanent power station for the West End street railway in Boston. This plant is being erected on the site of the old Hinckley Locomotive company's works. The idea is to have this power station as regards size, excellence and adaptability for its work, excel any yet constructed. The aggregate capacity of the engines will be 13,000-horse power. These, which are being built by E. P. Allis & Co. of Milwaukee, Wis., will be thirteen in number of 1,000-horse power each,



WEST END RAILWAY POWER STATION AT BOSTON.

of the Reynolds-Corliss triple expansion type with condenser. The three cylinders measure respectively 21, 36¾ and 52 inches in diameter, with a 42 inch stroke. The fly-wheel which is 28 feet in diameter with a 10-½ feet face, and weighs sixty tons, will make sixty-eight revolutions per minute. Each engine will drive by means of two belts, each five feet wide, four specially designed Thomson-Houston generators compound wound, four-pole with Gramme ring armatures. These armatures are nearly five feet in diameter, with six inch shafts and will make 400 revolutions per minute. The boilers, engines and smoke stack will rest on granite foundations supported by about 700 piles forty-five feet long. The stack will be 250 feet high, circular in form, double brick shell twenty-six feet diameter at base, and seventeen at top, with a flue of a uniform diameter of thirteen feet. The



WEST END RAILWAY POWER STATION AT BOSTON.

illustrations are reproduced from the *Street Railway Journal*, New York.

Result of Wire Cutting in New York.

The revulsion of feeling in the question of cutting electric wires in New York city has already become manifest and each day the newspapers of the metropolis bear evidence of the resentment of merchants. A manufacturer is quoted as saying: "Why, when the wires were cut without notice to us, every one of those sixty machines stopped, and the girls were thrown out of work. We had put in an electric motor and got a wire from the Brush company, and all the machines were driven without noise or dirt or the annoyance of escaping steam, all the power being supplied by one wire. The first we knew, the wire was cut. There was no subway in the street, no way to have electric power supplied, and we had to stop our business until we could buy a steam engine and put it up and connect it with the machines. Meanwhile these poor girls, earning from $8 to $18 a week, lost their time, and we were put to the inconvenience of the change. There was nothing else for us to do but to stand the expense on our part, and let the poor girls stand their loss. If we had not been pretty quick about it our hands might have been idle yet. If we could get electric power again we would take it."

Small store keepers who could not afford a private installation, were left in gloom and darkness and their loss during the holiday season was indeed very heavy. This class complains bitterly of the action of the Board of Electrical Control upon which the blame is placed for the unfortunate state of affairs "It is a remarkable thing," said a Broadway merchant, ' that while New York has had this terrible scene and loss of life, and its Board of Electrical Control, and its subway company charging a thousand dollars a mile for the use of the subway, they have had nothing of the kind in Brooklyn—no loss of life, no Board of Electrical Control, and no subway company. The reason is simple. The companies have been permitted to manage their own business. If they wanted to make repairs they made them. The main trouble in New York has been that the Board of Electrical Control has prevented repairs, and has actually created most of the dangers. They seemed to be anxious to make pretexts for cutting off the wires of certain companies. They have refused to grant permits to repair poles and wires in places where there were no subways and where there will not be any subways for years to come."

The New York *Sun* commentiog on the present state of affairs says: "The sudden cutting of the wires has shown in a striking way how intimately applied electricity has become connected with the business of the city. Electric light and power are inseparately interwoven with the necessities of the people. Electricity has become one of the factors of life. The problem of the hour is to make it safe as well as convenient."

Two Important Decisions.

Judge Gary of the Appellate Court of Illinois, handed down two interesting decisions at Chicago last week, in the Great Western Telegraph litigation. This institution is in the hands of Elias R. Bowen, receiver of the Circuit Court who has sued the stockholders all over the country for unpaid subscriptions of stock on an interlocutory order which decrees their stock liability. The stockholders have been making a fight all along the line, and have started all manner of suits to set it aside.

Eugene C. Bates and thirty-three other owners of stock filed a bill in chancery to review the interlocutory decree, and the Circuit Court sustained a demurrer interposed by the receiver, for want of equity. The Appellate Court has affirmed this decision, and its ruling is that whether the interlocutory decree was properly entered or not it cannot be made a subject of inquiry by this sort of proceeding.

The other case decided was that of W. H. Bush, who sought to escape payment of his stock liability when sued by the receiver on the ground that he had bought the stock after it had all been taken. In other words, he was not an original subscriber, and hence was not liable. The Appellate Court holds that the Supreme Court passed on that point in the Gray case and decided that this made no difference. Moreover, Bush had waived the right to make this objection by paying on assessments 40 per cent of the stock and not repudiating his liabilities when he might safely and profitably have done so. Judge Gary also held that the rosy hues with which the agent of the telegraph company tinted the future of the corporation could not be made the basis of the charge of fraud. There are 3,000 stockholders in this company who will be affected by these decisions which will materially diminish the loophole of escape from liability. Senator Farwell, representing himself and many other stockholders, has a suit pending to get out of paying stock subscriptions in the Great Western Telegraph company. He charges fraud and claims that money enough was raised to pay the debts of the company without resort to the stockholders, but that it was misappropriated by certain parties. The amount due from the stockholders is several hundred thousand dollars, and the suits of the receiver growing out of this old litigation have long been a bugbear to many prominent men.

A short time ago the newspapers of the Western cities were calling upon the authorities to cut electric wires, but they have changed their tune of late. The Cleveland, O., *Plaindealer* last week said: "No better proof that street lamps are the most effective police agents could be asked than the great increase of crime in New York City since the electric light wires were cut. The surprising number of highway robberies and kindred offenses of late has attracted attention, and there is no doubt that it is directly due to the sudden darkness which has settled down upon those districts until lately illuminated by electricity. The money a city puts into street lighting is a profitable investment. A street lamp is better protection against robbers than a policeman. If our streets and alleys were better lighted at night, there would be fewer women assaulted, fewer footpads and burglars abroad."

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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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A DISPATCH states that all electrical companies in Pittsburg, Pa., have agreed to put their wires underground within a year.

A VIEW of the dynamo room of the Brush station in Rochester, N. Y., is presented in this number. The machines are operated by water power and the station is one of the most interesting in the country.

AT the meeting of the Chicago Electric club last Monday evening, Dr. Louis Bell addressed the club on the "Theory of Compounding for Constant Potential." An abstract of his remarks is presented in another place in this issue. The club voted to entertain at a lunch the delegates to the National Electric Light convention at Kansas City, if their train remained long enough in the city.

THE Cleveland *Leader* in an article on the tariff comes out strongly with this statement: "It was never intended that the protective tariff should be used to aid a foreign syndicate in keeping up exorbitant prices, and whenever it is found that it is perverted from its original and just purposes to such unjust uses it should be repealed. In the revision of the tariff to be made this winter the duties on copper should be removed."

A CASE which came before Judge Tuthill in Chicago, last week, is of special interest to telegraph operators. The question involved was whether the superintendent of the Western Union Telegraph company could be compelled to testify in regard to an alleged "black-list," which had been sent to him. The court found that the superintendent could not fall back upon a plea of privileged communication, but must answer the question in regard to the "black-list." In an article on another page is given a sketch of the case.

THE price of rubber is to be materially increased if reports are to be believed. It has already been stated that the Brazil authorities have imposed an export tax on rubber in favor of a local company, and this tariff, according to the latest advices from Para, may be increased. As if this were not enough, a rubber trust has been organized in Trenton, N. J. The dispatches say: "British capitalists are to take an interest amounting to about $3,000,000, and to push the stock in England and Scotland. While the identity of the capitalists has not yet been disclosed, they are believed to be the same ones who bought up a number of American breweries recently. The trust will not take the active management of the local concerns, which will continue under the present operation, but will, of course, dictate a policy of unity of action in all business dealings. The negotiations for the establishment of the trust began about two months ago." The reports seem to tell a pretty straight story, but the reference to the English capitalists rather makes one distrustful. It is hard to believe that these capitalists should be credited with as many schemes as the newspapers would have us understand.

IN the autobiography of Joseph Jefferson which is now being published, appears a paragraph describing the introduction of the telegraph at Cumberland, Md. Jefferson was in the city at the time and received a dispatch in response to a letter he had sent to Baltimore on the previous day. The rapidity with which the reply had come seemed incredible to Jefferson, and he hastened to the telegraph office to ascertain the truth. He continues this story in his inimitable way: "A small group of people had collected about the operator, some having received messages of congratulations at the establishment of the line, others sending them away to the same effect and all wearing a look of surprise and incredulity. We began showing one another our dispatches and looking with respectful awe at the mysterious little machine that was ticking away as if worked by some invisible spirit of the other world, wondering what they would do next. The whole town was up in arms about it. People were running to and fro with little messages in their hands and stopping one another in the street to talk and wonder over the new event. If I were now to receive a message from the planet Mars offering me a star engagement, I could not be more astonished than I was on that day. It is said that the man who invented spectacles was imprisoned for daring to improve on the eyesight that God had given us, and that these comforts of old age were called 'Devil's eyes.' So in the height of this telegraphic novelty did many wise old solons shake their solemn heads declaring that the wrath of God would fall on those who dared to take a liberty with lightning. The people with universal consent made the occasion a holiday."

THE crusade against the electric light companies in New York city was carried too far, and of course a reaction has set in. In the last issue of the WESTERN ELECTRICIAN was presented a timely and temperate article from a New York paper in which the subject was discussed. It was admitted that the loss of the electric light as a result of the destruction of overhead wires was proving a far greater evil than that which was incident upon aerial circuits. An equally sensible article appears in the Boston *Herald*, which relates to this subject. It says: As we predicted at the time, this sudden outburst of unreason has been followed by a recovery of sense. Not only do the people of New York city find that gas is but a poor substitute for the street illumination formerly given by electric lights, but the proprietors of stores, in a great number of cases, are complaining that in consequence of the absence of brilliant illumination, their business cannot be carried on in a satisfactory manner. Nor is this all. Electric motors were used in a large number of instances, where other power was unobtainable, in working sewing machines and other pieces of light machinery. Necessarily, these methods have been abandoned, and many men and women have been thrown out of work, involving, in individual instances, great personal loss and suffering. Some of our New York contemporaries who became panic-stricken are beginning to perceive the folly of their action. This return to reason has not taken place with all of them, but it is evident that a reaction has set in which will soon place the municipal authorities of New York in an exceedingly peculiar position, for, having destroyed the poles, structures and wires of the electric companies, and having no other satisfactory method of obtaining the needed light and power, they may soon be compelled, in obedience to another aroused public demand, to ask the electric companies to in some way re-establish themselves.

IN the last number of the *Forum* Prof. R. N. Thurston, director of the schools of mechanical engineering of Cornell University, discusses in an entertaining way the "Problem of Air Navigation." After reviewing many interesting experiments in aeronautics, Prof. Thurston thus speaks of the probability of the ultimate solution of the problem: "The researches of Langley have shown the power demanded for flight to be about 2 per cent. of the amount once supposed a minimum. We know that nature's energy can be directly converted into useful power through the production of electricity as in the gymnotus, and possibly in all animal mechanisms. We know that modern storage batteries are ten times the weight that science indicates to be the limit of perfect efficiency; both steam engines and electric accumulators have been made light enough and powerful enough to raise their own weight, with something to spare. The flying lemur, the flying squirrel, the rude sustaining membranes that inventors have constructed, have sustained their heavy weights in drifting many yards. Man has imitated such animals; his predecessors the bats and the great pterodactyls have flown on membranes. Why may not he hope sometime to combine the highest products of his inventive genius in some contrivance which shall enable him to drive his fusiform balloon a hundred miles an hour defying wind and storm; or why not hope to learn from the albatross and the condor and the eagle the secrets of flight, and like them, to soar aloft and above the clouds, to glide hour after hour on widespread, motionless wings with the speed of gales that vex the earth below, and as far as the wild goose or the carrier pigeon or the migratory eagle can fly, crossing continents and oceans, as certainly and even possibly as safely as do railway trains or steamships to-day? It would be rash as yet to assert that all this is even possible; but it would be still more rash to assert the contrary. Man has accomplished hardly less wonderful tasks. Who shall say that the limit of his powers of invention and construction has been reached or even approached? The engineer, like the man of science, has an infinity of opportunity still before him. And it is to the combination of scientific knowledge and constructive talent of the engineer rather than to the haphazard operations of the hand and brain of the ignorant contriver of olden time that we are to trust, if at all, for the accomplishment of this, the most stupendous of his tasks. Scientific research, exact computation, precise adjustment of means to well-understood conditions are the lines which lead to final success."

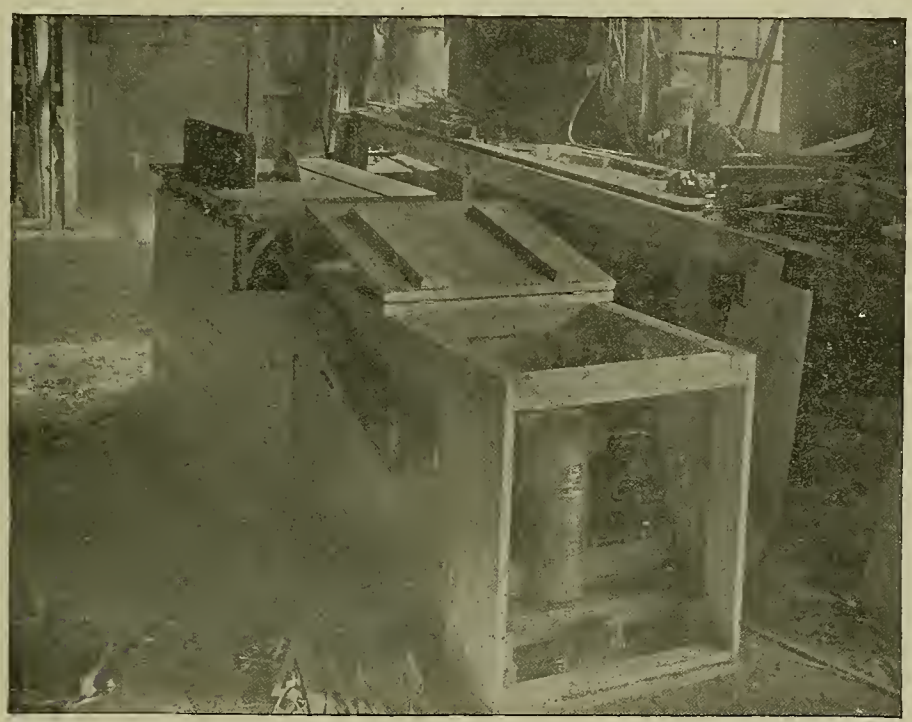
Standard Wiring Table.

At the December meeting of the council of the American Institute of Electrical Engineers, the following committee was appointed to formulate and submit for approval, a standard wiring table for lighting and power purposes: F. B. Crocker, chairman; Thomas P. Conant, Dr. Louis Duncan, Prof. W. R. Geyer, A. E. Kennelly, Geo. B. Prescott, Jr., Prof. E. P. Roberts, William Stanley, Jr., Dr. Schuyler S. Wheeler.

The committee decided to hold its first meeting at the rooms of the institute, 125 Temple Court, New York, on Friday, January 10. It is not intended by the committee to make any radical departure from the best practice of to-day, but rather to establish a table which shall be generally recognized and used as a standard. Suggestions from persons interested may be addressed to F. B. Crocker, Columbia College, New York City.

Operating Small Machines by Electric Motor.

The application of the electric motor to driving small machines is well shown in the accompanying cut. The motor is of Thomson-Houston manufacture, three-horse power, and is belted directly to the saw. It has been in use since October, 1888, and has given the most excellent results in every way. The fact that it is available at any time, and can be started and stopped so readily, renders it particularly economical for this class of work.



OPERATING SMALL MACHINES BY ELECTRIC MOTOR.

Test of the Forbes-Timmis Electric Brake.

In a recent issue of the WESTERN ELECTRICIAN a description of the Forbes and Timmis electric brake was presented. This apparatus was recently given a practical trial on a train on the London and Northwestern railway. The details of the tests which were made on the London and Birmingham main line, are given by the London *Electrical Engineer* as follows: An old-type coach, with four wheels only, was fitted with the apparatus. In one of the compartments was a battery of seventeen storage cells. The brake handle is simply a switch, to complete the circuit to the magnetic iron disks of the brake, with a resistance regulating the strength of current. After the 8:40 London train had left Adderley Park Station a large engine was attached to the coach, to which an ordinary brake van was linked in case of emergency. The line between Adderley Park and Stechford, over which the run was made, is in every way suited for such a trial, there being a straight run for nearly a mile and a half, over an almost level line. On this portion of the track, a distance of a quarter of a mile was marked off by fog signals, on account of the mist, and a sufficient space being allowed for the driver to get up speed, the signal to start was given. At the end of the distance the coaches were slipped, and although running, as was afterward ascertained, at the speed of thirty miles an hour, were brought to a standstill in about 200 yards. This was considered to be a very good trial, inasmuch as the rear van was running free, and would necessarily impel the first coach over the lines, coated as they were with a film of ice. Two or three other trials were made with almost precisely similar results, and Stechford was then reached. As it had been demonstrated that the electric brake was effective the guard's van was detached, and trials were made with the single coach. The results arrived at were of a more satisfactory character. A half-mile run was tried, and the coach slipped while traveling at the rate of forty-two miles an hour. The brake being instantly applied, brought the coach to a standstill in 150 yards. No doubt that distance would have been considerably diminished but for the fact that the wheels, being instantly locked, glided along the glazed surface. It might naturally be expected that the sudden application of the brake would have manifested itself in an unpleasant manner to the occupants of the coach; but the application was only slightly appreciable by the nine occupants. This is attributable probably to the fact that the brake is in no way connected with the body of the carriage, the magnetic disks being kept in position by stays running from one to the other. The trial lasted for about three hours, the best result obtained being the stopping of the car in sixty yards, when traveling at thirty miles an hour. The experiments were considered by the company's officials to be highly satisfactory.

The New York Question.

The people of New York city are slowly awaking to a realizing sense of the folly into which their scare on the subject of electric light wires so suddenly carried them, says the Boston *Herald*. The systems of arc lights for street and house purposes and electric motors for ordinary manufacturing uses have been destroyed by municipal action through the greater part of the city, a result brought about by the death of two men who were killed while engaged in the work of repairing electric wires, a fatality for which the carelessness of the victims was possibly the chief cause. But the eagerness of some of our New York contemporaries to start a sensation which would enable them to pose in the light of public benefactors led them to enter upon an indiscriminate crusade against the electric light and power companies, and in a rash moment, in obedience to a supposed popular demand, the poles and structures supporting electric light and power wires were destroyed and the wires themselves removed.

Theory of Compounding Dynamos for Constant Potential.[1]

By Dr. Louis Bell.

A short time ago I came across a certain fact that seemed to bear on the theory of compounding dynamos to produce constant potential; I was sufficiently interested in the fact to work it out. It is not complete, for the simple reason that I have not had the opportunity either to revise it or to obtain such experimental confirmation of it as I hope to do later. In general we can say that the object of compound winding a machine is to avoid extraordinary trouble. If constant potential is desired, it is a possible thing to produce something very like it by a shunt winding alone. It has even been said that a shunt machine with no resistance to speak of in the armature would give a constant potential. That is not quite true, but it is certainly true that a shunt machine with very powerful magnets and very small resistance in the armature will give a potential that is very nearly constant; but to produce such a machine is decidedly difficult. It is not merely a question of designing skill, but sometimes it involves a great deal of trouble, a great deal of added weight and considerable added expense to produce a machine whose field magnets are so powerful as to completely overpower the armature and produce with simple shunt winding somewhere near a constant potential. As a result compound winding has been devised. It is at the same time to be regarded as a labor saving device, as a device for improving a shunt machine, designed and made with proper skill and care, and not at all as a device for making a tolerable compound wound machine out of a bad shunt machine. The result of compound winding of that sort I do not think would be satisfactory from either a practical or theoretical point of view. I shall introduce tonight one machine that evidently was built in that way. One might call it a lazy man's machine—a shunt machine very badly designed and changed to a compound apparently to make up for these deficiencies.

We might start the discussion by asking why a shunt wound dynamo having powerful field magnets, and an armature not very powerful relatively to the field magnets, should not maintain a practically constant potential. The answer which has always been made to that question, and not quite the correct answer is, because the armature has resistance. If, for instance, we have a shunt wound machine which will give 100 volts on open circuit when worked at its full capacity, the armature will absorb a certain amount of the voltage, so to speak. In other words, a certain amount of voltage is necessary to overcome the resistance of the armature when a powerful current is being passed through it. Therefore a machine which gives 100 volts on open circuit, would not give the same amount with a powerful current passing through it, because the armature has an appreciable resistance, and a certain amount of voltage is absorbed there. There will be then a drop in voltage. That amount we can calculate readily. If we have a machine which will give E volts at a certain speed on open circuit, and have an armature with a resistance of R, and then pass the current, C, through it, we will get a drop in voltage which I will call e, equal to $R\,C$. And that is the approximate reason why we have to resort to compound winding, or why it is sometimes convenient to do it. Now the first and natural suggestion is to put on enough series turns to make up for the loss of e volts. Now that is very simply done indeed, and the result, taking the formula $a=\frac{eN}{R}$, would be that A, the number of series turns required to do that work would produce e volts, and bring the voltage up to the point where we started.

Now if that were all that were necessary I should not be reading this paper now. Compound winding would have been worked for all it is worth, and that would be the end of it. Unfortunately that is not enough, and for this reason: The voltage at the terminals has dropped on account of the absorption of voltage in the armature. Now if we are to get 100 volts at the terminals, we must produce in the machine more than that, because we are using up a certain amount, e, in the armature. In order to accomplish that, the induction through the magnets must necessarily be increased, and the other factors remain constant; that is, the speed and number of wires in the armature. I am going to use the term "magnetic resistance." I am aware that it is a term that is not in good theoretical standing. I see that Mr. Fleming, in his recent book, has used it, and I am going to make bold to use that term, because it is convenient. We then meet the difficulty that this number of series turns, A, will not do the work, because by adding the necessary induction, we increase the magnetic resistance a certain amount. Suppose we call the magnetic resistance of the machine at the start q; call the resistance at full load, the resistance when we put on the maximum induction that we are going to use qx. The magnetic resistance then is increased in the ratio of $\frac{qx}{q}$. Consequently in order that the series turns added should produce e volts to make up for that drop in voltage, we must wind on not A series turns, but a number rather larger than a, to compensate for the fact that the magnets have increased in magnetic resistance. In other words, it would be in the ratio of $\frac{qx}{q}$. That is the point where S. P. Thomson in his well-known book dropped the subject, and that is the point where, so far as I know, nearly everybody else dropped it. That is very pretty, so far as it goes, and it is perfectly correct so far as it goes, and that is all. Anybody who attempts to build a compound wound machine according to that formula, will find himself very sad when he gets through, because he will not get a constant potential by any such machine. The next question is, why? It is perfectly evident that if that does not give the result there

[1] Abstract of an address before the Chicago Electric Club, January 6, 1890.

is some good and sufficient reason for it; that there is something we have forgotten, and that that something probably, judging from the results of trying to use the formula, is a very important something. The first thing is this: We have increased by adding series turns the magnetic resistance in the ratio of qx to q, and that applies to the shunt windings as it does to the few series turns that we have added, for by adding these series turns and increasing the induction, we have increased the magnetic resistance. Then surely the number of shunt windings which produce E volts, when the magnetic resistance is q, will not produce it, when the magnetic resistance is qx. We must add then, either more shunt turns or an equivalent in series turns. And that is one of the important things which has been neglected in the question of compound winding. It is not very difficult to compute that amount. The shunt ampere turns sufficient to produce e, when the resistance is q of course will not produce it when the resistance is qx; therefore, we must add enough series turns to bring the induction up to its proper value.

If the iron is not nearly saturated; in other words, if the machine were properly designed in the first place from a magnetic point of view, that quantity will not be a large one. So that so far as things considered up to this point are concerned, we should we have properly the e volts with which we started out, the drop in the armature having been counteracted. But unfortunately another term has been neglected in the question, and one that is still more important. I think every man who has built a compound wound machine, will be able to have a tolerably clear idea of what that term is, although the value of it has not been taken into account properly. It is a term that is caused by the demagnetizing effect of the armature current. The armature is cross magnetized and the field is disturbed by it, and as soon as the brushes are given a lead, to get them to a point where they will not spark, the effect of the armature begins to make trouble and demagnetizes the field magnets. There is a certain contrary magneto motive force in the armature owing to the fact that it is running with lead, and has to be run with a lead on account of the disturbance between the field and the pole pieces. The demagnetizing effect upon the armature may rise to such a considerable amount as to cause serious trouble, particularly if the machine is a high potential machine, and there are very many turns in the armature, or if the machine has insufficient iron in the field magnets the same result will follow. That amount has been and is very readily worked out in terms of the number of windings on the armature. Its effect is quite large in some cases, so that instead of saying, as one customarily does, that to build a shunt machine to give a constant potential, you should have little or no resistance in the armature, we should also have to say in addition that it should not have any convolutions on the armature to speak of, or it will give the cross magnetizing effect. It should be noted right there that everybody knows who designs machines that the sparking trouble that compels one to shift the position of the brushes to get them to a non-sparking point, is very considerably affected by the shape of the horns of the pole piece. Sometimes a little tact in changing the shape of the ends of the pole pieces will enable one to run with a great deal less lead, and get a very much more workable machine. But to return to the demagnetizing effect of the armature. That amount has been worked out by Hopkinson, although it is not quite compound winding. It was worked out by him in that admirable paper, published in 1886, which I was about to say contains the sum and substance of the theory of the dynamo; it is a paper which has not been read as much as it ought to be. He worked out the cross magnetizing effect of the armature, the demagnetizing effect, and found it to be the following: The formula is $4\pi C \frac{m}{2} \frac{2l}{\pi} = 4 \text{ Im C}$. In other words, he found the magnetized effect in magnetic units depended upon the angle of lead of current, and the number of convolutions in the magnet. Now having this demagnetized effect of the armature all we have to do to counteract it is to reduce it to its corresponding number of series turns, and that comes out very simply. Suppose we call C the number of series turns necessary on that account; we have C equals the simple quantity $C = m \frac{l}{\pi}$. In other words, the number of series turns which will have to be added to counteract the demagnetizing effect of the armature equals the number of turns on the armature, divided by the quantity $\frac{1}{\pi}$ where l is the angle of lead.

Now then we have those three factors which go to make up the series turns necessary to give a constant potential machine. The first one, the one which has been known for a good while due to the fact that the armature has a resistance. The second one, due to the fact that the magnetic resistance of the machine increases as one computes the series turns to take care of the first turn. And finally, still more series turns must be added to counteract the demagnetizing effect of the armature. And they come out in respectively simple forms. The only trouble is this quantity, $\frac{qx}{q}$. We don't always know what qx is, although we ought to know very nearly what q is if the machine has been carefully designed in the start. But it is quite easy to get an approximate idea of qx from almost any of the published curves of magnetization. Those in Hopkinson's paper are perhaps the handiest to work with that I know of. If any one knows anything about the iron that is used in building a machine, he can arrive at a fairly good idea of qx. It is a quantity that is quite obtainable. I think that these three terms include all the terms which are of sufficient size to be met with in actual dynamo building. Theoretically, they are not all that would have to be taken into account, and I have omitted in the first place all terms involving the square and higher powers of the ratio, because they are quite small; in the next place all terms involving the differential of that ratio, and finally the periodic terms which involve the self induction of sections of the armature and things of that kind. They are very small, I think, compared with either of these three terms, and so small that they need not cause very much trouble in practice. One thing more so far as these terms are concerned, and the work is complete. These series turns should be wound on the magnet. Consequently the number of series turns, whatever it is, deduced in this way, would have to be multiplied by the co-efficient of leakage of the machine, whatever that may be. That co-efficient is very seldom as low as 1.25 and not very often as high as 1.9. So we will have to multiply the number of series windings derived in this way from these three terms, by that co-efficient, whatever it may be, to get the total number necessary. There is quite a wide variation in the value of leakage, and of course any form of magnetic frame that we are tolerably well acquainted with, we can make a very close guess indeed as to the actual value of this co-efficient.

I added these two terms, B and C, and looked to find specifications in some compound dynamo for the sake of applying this, and seeing whether it actually gave the proper number of series turns to be applied. I was not very lucky in that search. I had little time in which to look, only a couple of days, and I did not find very much, and I am compelled to use as an illustration a machine which shows a necessity for the corrections more than anything else. It is the machine described by Thomson. It is a four-pole machine with a gramme armature. The armature contains 320 turns with a resistance of .025 ohm. The total resistance of the series turns was .005 ohm, making .03 ohm the total resistance. The dimensions of the machine are partly given, but the machine was built with very much too little iron. The iron was very much over-saturated. In fact, the amount of iron was so small as to be very objectionable, the over saturation being very severe. The details of the machine were not given as perfectly as I would like to have them I had to make a guess for the ratio. The guess I made for that was $\frac{qx}{q} = 1.3$. The leakage I take is 1.6, which was not an excessive amount, I think, for a four-pole machine built on these lines. It is rather small, if anything, considering the character of the machine. Finally the leakage I took as $l = \frac{1}{16}\pi$, which I think is not a large lead for a saturated machine; a machine where there is too little iron and with quite a powerful armature.

These three quantities I judged, as far as I could without working them through to see where they would lead me. Having taken those I proceeded to put them into these various formulæ with the resistances given, and the number of shunt terms given, which was 352, as I mentioned before, on each of the four poles of the magnet. The result I found was this: Taking these terms one by one A=8 turns, B=20 turns, showing that this factor which has been completely neglected in most work of this kind was in this case more than twice the quantity which Thompson would give for the full number of series turns necessary for compound. And then working out the armature turn, C=32, it makes a still further increase. In fact the amount owing to the armature alone was 4 times the number given by this old standby formula. Then multiply the whole by n, the co-efficient of leakage of the machine, we get 96 series turns as necessary to compound that particular machine. Having worked that out I turned back to the description of the machine, 96 was the series turns on that machine. In other words I happened —I say happened, because I did not know exactly what those were,—to get precisely the number of series turns that were required as found in practice to compound that machine. Now, I do not know whether it was well compounded or badly. Judging from the general design I should say that it was not compounded very well. At all events, it is quite clear that these three terms give a close approximation to the actual number of turns found to be necessary. If that is true in a machine so thoroughly saturated, a machine with altogether too little iron in it, and a machine where the voltage at full load, without compounding, must be barely over half the normal voltage, which is 65; if it works properly in a machine of that kind, so as to give approximately the number of turns required to compound it, it certainly ought to do so where the number of volts to be accounted for is one-tenth of the total number produced. I have not been able to get any other machine to which I could apply it, but from the result of that I am convinced that it is a fairly good approximation to the number of terms actually required in practice.

In closing I would reiterate again what I said at the start, that I do not think the compound machine ought to be abused in the way it was when the machine that gave these results was designed. It is too much to ask a machine to do, to scrimp it on iron, proportion it badly, and then expect it to give constant voltage; it simply will not do it.

I will say that these formulæ will compound the machine correctly, I think, when the voltage due to the shunt turn is E. Consequently it will compound correctly when the machine is run at such a speed that the shunt turns alone will give E volts on open circuit, and that will be the speed for compounding, and the speed at which these formulæ represent, I think, nearly the proper amount of series turns. Of course if the machine is run at any other speed, in other words, if the shunt windings give more or less than E volts the machine cannot be expected to compound. It would not compound, and everybody knows very well that a compound machine is sensitive to changes of speed.

I wish very much I had obtained the details of several compound wound machines, which were properly designed at the start. I have faith to believe that the results would be much better; that these formulæ would represent the series turns necessary much more closely in case of a machine properly designed to start with, than one which I know was badly designed. I hope to be able to do so in the future.

Electrical Engineering in America.

By G. L. Addenbrooke.

PART III.

Returning to the Pittsburg station, five Westinghouse engines of 250 indicated horse power drive five alternating-current dynamos of 2,500 16-candle light power capacity each besides the machines driven from the Corliss engine. The exciters are run from smaller engines. The engines driving the alternating dynamos make 250 revolutions per minute, the dynamos making 1,050 revolutions per minute. The power is conveyed overhead by belts to the first floor, where the dynamos are placed. Each of these dynamos is on a sliding bed, so that the belt can be tightened, and, as I have already said, the exciters are run separately from the machines. The machines are so well known it is hardly necessary to describe them. I may, however, with advantage say a few words on the construction of the armature, which is the least easy part to understand from written descriptions or diagrams. In Prof. Silvanus Thompson's book on dynamo machines the diameter of the armature is given at nearly twice its breadth. While this is true of the smaller machines, in the 2,500 machine—which is the standard size for large stations, and is the size employed in the new station in Sardinia street in London—the length of the drum is considerably greater than the diameter. The drum itself is formed of thin iron plates, just like an Edison armature, only of larger diameter; and as the iron near the center is useless, holes are punched in the sheets, which lightens the armature, and secures ventilation. Round the outside of this iron core and over the two ends insulation is laid. As regards the coils of wire in which the current is generated, they are made in this way: Beginning at the inner side of the coil the wire is wound on an oblong frame to correspond with the shape of the field-magnets, one turn on the top of the other. The coils are only one wire thick—that is, there is only one layer of wire between the drum and the field-magnets. When these thin flat coils are laid on the drum, the round ends of the coils are turned down at right angles over the edge at each end of the drum, and the connections from coil to coil are made. A small piece of wood screwed into the side of the drum and projecting over the end of each coil, keeps it in its place. When all the coils are fixed in their places, sheets of mica are laid over them all round the armature and bands of fine wire with a little thicker insulation underneath them are bound round the whole armature at short intervals, in exactly the same way as is usual with the armature of continuous current machines. An armature made in this way has perhaps an amateurish look about it, but there is no doubt they work well in practice and give excellent results. It is further worth noting that as the field magnets are long and narrow—a ratio of at least 10 to 1 in the large machines—they cannot be very economical as far as exciting current is concerned. Still, since the exciting current anyhow, bears such a small ratio to the energy which the machine will transform into electric current, this is not a very material point.

The mains are run from the dynamos to the switch-board in troughs cut in the joists supporting the floor, which is made to take up over these troughs.

The switch-board at Pittsburg consisted of a wooden frame boarded over, about 9 feet high and 12 feet or 14 feet long, and standing about 3 feet from the wall, so as to give room to go behind and make the connections. This, I may say, is the usual way of arranging switch-boards in America.

The general type of switch used in America for alternating-current work, and it is not confined to the Westinghouse company, is exceedingly simple in construction and operation, as well as efficient. In general principle it is like an ordinary tobacco chopper. To the top of a small upright a lever is hinged, terminating in an insulated handle. The metal part of this lever has a hatchet-shaped projection cast on it, projecting in the same plane as the motion of the lever. When the lever is pulled down the hatchet-shaped piece sticks in between two spring pieces set up to receive it, and so makes contact. If the lever has two hatchet-shaped pieces attached to it opposite each other, and engaging in spring pieces on either side, according as the handle is thrown over in one direction or the other, we have a two-way switch. Unite two of these levers together by a cross-bar of insulating material, with a handle in the middle, and we have a double-pole two-way switch. Place a spring in the columns holding the hinges on which the levers turn, to throw down the levers when nearing the spring contact pieces on either side, and we have the complete article. These switches were all mounted on wooden bases. In fact, I saw no slate used in America anywhere for such purposes, except at the Electric club in New York. In the new Westinghouse station in Sardinia street, however, the whole of the switches are mounted on enameled slate, and very nice they look.

One exciter is used for several machines; each exciter has a resistance in its field-magnets, which can be varied. There is, moreover, a separate resistance in the field-magnet circuit of each alternating machine, so that the e.m.f. of the machine can be varied while its speed remains constant.

Double throw-over switches are connected so that each alternating-current machine can be connected to either of two exciters, and so that any main circuit can be run from any machine. The general principle followed is to keep the machines at work as fully loaded as possible. Thus in the day many circuits will be run off one machine, but as evening comes on they will one by one be taken off and put on other machines. The throwing over is so quickly done as to only just cause a perceptible flicker in the lights. All these switches were bare and unprotected.

I did not hear or see much of the method of running two separate machines parallel on the same circuit. Whatever may be done in isolated instances, it does not appear to be practised generally; indeed, with the American system of running a number of small circuits instead of fewer

heavy ones, the desirability of doing so does not often come in.

I should like to indorse here what I see Prof. George Forbes said in his paper on foreign central stations with regard to feeders. The area which can be economically supplied from a central station has certainly been greatly increased by the adoption of 1,000 or 2,000 volts instead of 100. But at the same time our notions of the area which can be supplied from one center have experienced a corresponding growth.

If, then, such an increased area is supplied on a high tension system from one center, we have as great, or nearly as great, falls of potential to deal with as if the low tension system were used over a correspondingly smaller area.

To secure the highest class of lighting, therefore, together with the flexibility desirable in an installation lighting a large area, the whole of the outside work should be based on as complete and carefully designed a set of feeders as from our present knowledge we should employ with a low tension system.

On many of the Westinghouse feeders lighting at great distances, there is a fall of potential of as much as 10 per cent. To avoid pilot wires an indicator is used, which, I think, Prof. Forbes has already described here. There is no regular voltmeter for driving the machines by, but an indicator is used with but one single mark on the dial. When the machine is giving the voltage which is required at the further end of the feeder to keep the lamps at their proper brightness, the hand of the indicator will be right over the mark on the dial. The loss in the feeder will, of course, differ according to the current flowing through it, so to allow for this a compensator is attached to the indicator. The main current flows through the compensator, which is arranged to cause a slight back-pull on the needle of the indicator; this pull becomes greater as the current increases. As the current increases therefore, a slightly higher voltage on the machine will be necessary to keep the needle in its place. The instruments have, of course, to be made so that they can be adjusted to the calculated requirements of each feeder. When once set right, however, their operation is simple enough.

The Westinghouse company also use a piece of apparatus containing an adjustable converter, which enables them to supply current from the same machine to two feeders having a different fall of potential.

The Thomson-Houston station in New York is situated in Twenty-fourth street East, near the river, and occupies what was formerly a large sugar refinery. It is, therefore, a building of the warehouse class, but very strongly built. I was told that this station was neither so large nor so well arranged as their station in Brooklyn, but the latter, I regret, I had not time to see. Two boilers struck me here as out of the ordinary patterns. The simplest way to describe them is I think, to consider them as large locomotive fire-tube boilers set on end. The tubes are about 15 feet long, and the water line is about 10 feet up the tubes. This gives a considerable steam space above, through which the fire-tubes pass, superheating the steam generated, and thoroughly drying it. At first sight one might suppose this an uneconomical pattern, as the heated gases pass so quickly into the flue. But the gases appear to give out their heat well, for Mr. Foster, the station superintendent, told me the temperature of the gases going into the flue was not above 550° F. The lower portion of this boiler is, however, the interesting part. I cannot very well describe it without the aid of a diagram. The outer shell of the boiler is expanded out and prolonged about a couple of feet below the tubes. It is turned up at the bottom, and united all round to the crown plate of the boiler, into which the lower ends of the tubes are expanded. This prolongation of the shell then forms a circular hollow, or chamber, about 2 feet deep. The internal space inclosed by this hollow chamber forms the firebox or furnace, and is about 6 feet in diameter Any sediment collects in the hollow chamber, and can be taken out at manholes. There were two of these boilers in use, and it was in contemplation to increase their number.

The engine—and, there is only one—which furnishes power to this station, is a large compound condensing Corliss engine; the two cylinders being in tandem. It is a very fine piece of work of its class. It drives on to a large flywheel with a smooth face of about 60 inches breadth. This flywheel transmits its power to a line of countershafting, which is arranged on the floor above, by means of a large leather belt 58 inches broad and of great thickness. I think, in all, 17 machines are run from this line of countershafting—15 55-light arc machines and two alternating current machines; in this case the machines are on the same floor as the countershafting. The general construction of the Thomson-Houston alternating current machines is on the same lines as those of the Westinghouse company. The main difference is that instead of the ends of the coils on the armatures being turned over the edge of the core, as in the Westinghouse machine, the armature has a sort of prolonged lip all round the outside at each end, and the ends of the coils lie flat on this instead of being turned over. To their smaller machines, also, the Thomson-Houston company frequently add a commutator, and commute part of the current to excite the field-magnets, as Zipernowski, Deri, and Blathy are in the habit of doing. The switch-board here is on much the same lines as I have already described. It was all quite open and exposed; but I was told that in view of an accident which had happened there a short time before, they proposed to cover the exposed parts up.

This way of leaving the working parts of high tension alternating current switch-boards exposed is not confined to American manufacturers; a good deal of the Continental work is even worse. Yet all the different patterns of switches and converters could be protected at a moderate cost, and by the exercise of a very moderate amount of skill and ingenuity. I cannot help thinking that not to do so, to save money in this direction, is false economy.

ISOLATED PLANTS.

Let us now turn for a few moments from central stations to what are called "private installations" in this country, and "isolated plants" in America. I have already spoken of internal construction work, or wiring and fittings, in connection with central stations. With isolated plants there is not much difference. Of course the character of the work differs greatly in different places, as it does here, but, taking it as a whole, I don't think it is equal to our standard; whether from an engineering or artistic point of view. I noticed, by the way, that there is a much greater tendency to turn incandescent lamps upward in fittings, like gas-jets, instead of downward, as with us the majority of lamps are turned. Isolated plants are driven by steam and gas engines, located in cellars and basements, exactly like they are here. As you are aware, accumulators are not so generally used; I only saw the set at the New York Electric club. With respect to dynamos, the Americans have been fully alive to the developments, both theoretical and practical, in our knowledge of the magnetic circuit which have taken place during the last four or five years, and all their modern machines appeared to me fairly up to date in this particular. What I may be permitted to call the Edison-Hopkinson type, the Kapp type, the Manchester type, and the Weston type—the latter with two magnets placed horizontally—appear to be the favorites, just as they are here. The construction and workmanship of the machines appeared to be much on a par with our own. There is little to choose between in one or the other. As to the way the installations are run, judging by that crucial practical test, the look of the commutator and brushes, it is much the same as here, certainly, I think, on the whole, not better. The lamps, as a rule, I did not find any steadier, nor are they kept nearer their proper voltage than they are here. This applies to arc lamps as well as incandescent: there is no magic about arc lamps over on the other side of the water; they are subject to the same vicissitudes and uncertainties as they are here, and do not burn steadier than those in any moderate-sized station here where the appliances are such that the lamps get a fair chance.

The switch-boards in these private installations are nearly always mounted on wood, and there is even a disposition to cut things fine in the strength and solidity of these wooden baseboards, somewhat, as it seemed to me in one or two instances, at the expense of efficiency and lasting qualities.

ELECTRICAL TRAMWAYS.

Such very full accounts have been published of everything that has been done in this direction, that there is really little I can add to them. In the *Electrical World* for October 19 there is published a table of the electrical tramways in actual operation and under contract in the United States. The total mileage of both is 1,260 miles, with 1,884 cars, on 179 roads Of this, 716 miles were, it appears, actually being operated by electricity at the date of the return, and 544 miles were under contract. Of this total, 21 miles were worked by cars with storage batteries, and all the rest, with the exception of two or three miles, by overhead conductors.

Nothing can be simpler than the way these overhead conductors are put up. Two lines of posts, about 20 feet high, are set up opposite each other, one on each side of the street; light steel wires are run across from one to the other; a small iron holding piece is attached to the center of the steel suspender, and this holding piece carries a hare, hard-drawn copper wire, along which the current flows, returning by the rails. Where feeders are used, they run along one side of the street, and connections are made at intervals with the central wire. The way the conductor is carried round corners is on a par with the rest of the work. Posts are set at the further corners of the street, and from each of these two, three, or four steel wires are run at an angle with each other, meeting corresponding wires run from posts on the inner side of the curve. In this way the wire is made to take the form of part of a rough polygon, while the horizontal and vertical movements of the fishing rod connector on the car are sufficiently ample to keep the contact-wheel on the wire when the car is going round a corner.

This method of erection does not look very nice, certainly, but it appears to answer the purpose well. Such work could, I think, be more solidly carried out here for about £70 a mile. In a few places standards with projecting arms placed in the center of the street have been used for carrying the overhead conductor. If neatly constructed, there is no reason why these should be unsightly, and they can be used for the further purpose of lighting the streets.

A great point about these electrical tram cars is the way in which their speed can be varied. They can be run at three or four miles an hour in crowded streets and while turning corners, or in broad roads in suburbs where there is not much carriage traffic, the pace can be increased to 16 miles an hour. The cars are stopped very quickly and reversed, and will, of course, run either way on the same track.

The companies claim a reduction of 50 per cent. in the cost of working over the employment of horses, putting aside all the extra facilities which the electrically-propelled car gives. A very noticeable point about all electrically-propelled cars is the quiet and gradual manner in which they start and come to rest, and the evenness of their motion while running. In these points they greatly surpass both cables and horses. I took the opportunity of talking with a good many members of the general public in the train and hotels about the working of these cars. There is no doubt that the outside public thoroughly appreciate them, and understand their value. At present electrical tramway work is the most "live" branch of the electrical industry in the States, and every one connected with it was full of buoyancy and hope at its future prospects. It is really sad to think that after all the skill and care which has been lavished on electrical tramway work here, it should be dragging along in such a half-hearted and pottering fashion

While in America, through the kindness of Mr. Lockwood, I had an opportunity of going over the telephone exchange system of New York with him, and of seeing the Cortland street exchange, which contains more than 3 500 subscribers, and is capable of extension to double that number. I also visited the Western Electric company's factories, both in Chicago and New York, where all the telephonic apparatus for use in the States is made. Although a description of the present state of this industry would properly come under the heading of my paper, seeing that the paper has already extended to such length, and that, owing to circumstances, telephony is a matter of comparatively limited interest here, however important in itself, I will not say more about it, but will conclude with a few general remarks.

In the early portion of this paper, I endeavored to convey an idea of the roughness and crudeness of American outside construction work. After reading over the proofs of the paper, I do not think I have overdrawn the picture; rather it is underdrawn, if anything. At the same time, I do not wish it in any way to be understood that American engineers are necessarily rough and untidy in their ideas, and incapable of different work. Besides their electrical plant, the numbers of beautiful tools, crowned by the latest pattern of the phonograph, which came over here from America, point to an entirely different conclusion. In accuracy of workmanship and careful finish, when they consider it suits their purpose, the Americans are our equals, if not our superiors; the difference lies in the fact that our ideas often differ from theirs as to where this accuracy and careful finish should come in. English engineering would hardly dare to appear before its fellow-citizens as the responsible owner and designer of such a terrible eyesore as American outside work is; but the American engineer appears to look at it from a different point of view. It is not his business to think of his fellow-citizens. Each of his fellow-citizens, he considers, is quite competent and capable of taking care of himself. It is the business of the electrical engineer to forward and extend the applications of electricity. If in doing this he does anything disagreeable to his fellow-citizens, it is for them to protest when it becomes intolerable to them, not for him to think of it beforehand.

And I would like you to try and think for yourselves, and really feel the enormous facilities which American engineers have in the past enjoyed, and still enjoy, in extending their business, by simply being allowed to erect open wires everywhere through the streets. Even where wires are now being put underground, they are largely put underground in order to carry on existing work, and to extend it, not merely to take advantage later of what may chance to turn up on the route.

Besides this, we have all had it drilled into us by this time that it does not matter how perfect, how desirable, how useful a thing is likely to be, before it can come into general use the public have got to be educated up to it, to see it, and feel its desirability and utility, and its practicability—to understand it, each man for himself. Now, the American system of overhead wires and cheap line construction, bad as it may be in itself, has from the very first brought electricity home to everybody, right to their very doors, not so much as a luxury, but as a practical desirable factor of everyday life, an attraction to public resorts, and a good advertisement for business. Consequently, electricity is in America no more a wonder, but a fact of everyday life to an extent that it is not yet here.

Looking at their plant, looking at their apparatus, and looking at the facilities which Americans have enjoyed for extended practical experiments on a larger scale, it does not appear to me that their actual achievements, simply from an engineering and scientific point of view, have been greater than ours have, in spite of the apathy on the part of the public and investors with which we have had to contend. Still, the fact remains that they have done more business than we have, even considering the difference in population.

Of what work we have done so far, Englishmen may feel justly proud, and with better times I trust we may still be able in friendly rivalry to show that we are competitors worthy of America's best mettle.

DISCUSSION.

Prof. Forbes admired the realistic description of electrical work in the United States given in the paper and fully endorsed the author's account of American electrical engineering, particularly as regards the rough-and-ready way in which the work is usually carried out. Although this class of work may be necessary for the rapid extension of electric lighting (as well as of railways) in America, where great distances have to be covered, yet he thought the more solid construction adopted by English engineers would prove better in the long run. For some time past he had frequently heard of great advances made on the other side of the Atlantic, and expected to have heard something definite about them from Mr. Addenbrooke, but, with the exception of electric tramways, little change seems to have been made since his visit two years ago. At that time, however, most tramways were worked by accumulators. Information about motors and meters would have been very acceptable, particularly for alternating current work. Speaking of American factories, Prof. Forbes said that great attention was paid to testing, and as a result the efficiency of converters had been considerably increased. As regards distribution, he was glad to hear of the frequent use of feeders, and hoped they would be more generally adopted in England. In conclusion, he asked what kind of cable was used for underground work.

H. C. Donovan considered that the apparent disregard of insulation was to be attributed to the dryness of the climate, and expected to have seen this brought out in the paper.

W. P. Granville said the usual method of specifying insulation resistance of cables (viz., in megohms per mile) was unsatisfactory, and that the diameter of the conductor should be taken into account, for if this is not done the same material used on conductors of different sizes would give quite different insulation resistances. He also thought that the insulation tests of lead-covered cable should be made before sheathing, and while the cable is immersed

n water. In his opinion the whole subject required reconsideration

Prof. S. P. Thompson had hoped to hear that in the five years since he visited the States improved methods of wiring, etc. would have been adopted but no great change seemed to have taken place, except in the use of alternating currents. On his visit he obtained an insulator even more crude than the one described by Mr. Addenbrooke. This he promised to exhibit at the next meeting After making inquiries as to the kind of motor used in the constant current arc circuits, Dr. Thompson expressed his opinion that the alleged greater steadiness of American arc lights was not due to any superiority in the design or workmanship of the lamps, but to the greater personal pride and confidence which the attendants have in the particular system with which they are connected.

Mr. Swinburne pointed out the great difference which exists in the management of English and American factories, and thought the system adopted in the latter, where the perfecting of designs and the experimental work are kept quite distinct from the wholesale manufacturing part of the business, was most likely to lead to success. So far, however, he believed machines of English design better than American, for the weight efficiency of the former is generally higher. Referring to Mr. Granville's contention, he said that instead of insulation resistance being given in megohms per mile, they should be expressed in megohm miles for each size of conductor.

The President, while deprecating imperfect work in general, thought it advisable that English electricians should acquire whatever good could be got from the "rough and ready" method adopted in America, and considered that progress might be retarded by waiting too long to attain perfection. He was anxious to know how constant currents were used for motors, and also whether the overhead wires used for tramways interfered with the ordinary street traffic.

Replying to Prof. Forbes' question as to recent advances, Mr Addenbrooke said he had not concerned himself with them, for his object was to see the systems and apparatus in common use. As to motors he made no inquiries respecting their peculiarities, but as regards meters he was informed that numbers of the Westinghouse type were in constant use. He agreed with Prof. Forbes about the way in which testing is appreciated, and with Prof. Thompson as regards the interest which the men take in their work; the latter fact Mr. Addenbrooke attributed to better wages and great chances of promotion. Speaking of the insulation of cables, he thought the absolute thickness of insulating material should be stated. In reply to the president's question relating to tramway wires, Mr. Addenbrooke pointed out that they were placed eight or nine feet above the tops of the cars, contact being made by a "fishing-rod" connection. In some cases these wires are carried by brackets projecting from poles fixed along the middle of the roadway, the poles being also utilized for supporting arc lamps and for general lighting circuits.

Lant Carpenter, who paid a hurried visit to America during August and September, said he quite concurred in Mr. Addenbrooke's remarks about the temporary character of the work, particularly in the western towns. In many places on the Pacific slope he found that water power was extensively used, both for arc lighting and tramway work; one town in Washington, he observed, had laid down electric tramways before making the common roads. Incandescent lamps are comparatively rarely seen in the far West, and from enquiries he learned that where they had been tried, the stations were so badly managed that the life of the lamps averaged between 200 or 300 hours. Passing on to Canada, he said that Quebec, Montreal, and Ottawa were all lighted electrically by water power. Another fact that struck him was the large numbers of long-distance telephone wires in use in the States. He also noticed that many of the wires were now being put underground.

G. S. Ram said he could not agree with Mr. Addenbrooke on the glaring character of arc lamps fixed on poles, and added that the tower system had been almost abandoned in New York in favor of poles. He greatly preferred the blaze of light in that city to the comparative darkness of London. As regards the character of overhead work, he thought the account given in the paper was not overdrawn, and in support of this he exhibited a photograph of a building in Broadway, New York, in which hundreds of wires were unintentionally included. On careful examination of the photograph the insulation on some of the wires was seen to be hanging in shreds

C. E. Spagnoletti thought the necessities for insulation were so different in England and America that the systems could not be compared on the same basis To show the great variation or insulation resistances in the country, he said that on the South Wales branch of the Great Western Railway the insulation resistances of the telegraph lines varies from several megohms to a few thousand ohms according to the weather. He also mentioned the difficulties experienced by Mr. Edison when experimenting in London and at Ealing with his automatic chemical telegraph. The maximum rate he could attain there was 500 words per minute, whereas in America he could get 2,000.

Mr. Preece, speaking of insulation requirements in the two countries, said that in his opinion the differences arise from the facts that the prevailing English winds are warm and moistened by passing over the Gulf Stream, while in America, the shores being washed by Polar currents, the winds are cold and dry. Referring to his own visits to America, the speaker said he always benefited considerably by being associated with the 'go-aheadedness" of American engineers, and he believed that on visiting this country American engineers derived similar advantages.

A. Reckenzaun deprecated the wholesale condemnation of posts made by Mr. Addenbrooke, and said that many were not unsightly, while some were ornamental. He considered the paper chiefly a criticism of the bad work done in America, and the good work was barely mentioned. For example, little is said of installations in which secondary batteries are employed, although there are many in constant operation, and electric railways are not described

F. Reckenzaun concurred in his brother's remarks about the unfair criticism contained in the paper, and thought the differences of opinion arose from the totally different ideas as to the way in which electrical engineering should be carried out. In the American methods, he said, great skill and ingenuity was shown in combining economy with simplicity and efficiency. Although the arc lamps are not ornamental, yet they are simple and efficient, and cheap construction admits of them being universally used. He agreed in general with Lant Carpenter's remarks on incandescent lighting, but was inclined to believe its limited use was due to the people wanting the biggest and best light obtainable at the price.

CORRESPONDENCE.

New York Notes.

New York, Jan. 4.—The pole choppers and wire cutters have been working steadily since the decision favoring the Board of Electrical Control was handed down two weeks ago by Judge Barrett, and as a result of their labors about 1,300,000 feet of wire and 900 poles have been destroyed. The Mount Morris company which had not been disturbed before, suffered last Tuesday when its wires were cut by Inspector Fitzpatrick, of the Board of Electrical Control. The telephone company's service has been crippled by the wholesale cutting of wires.

The official death record for last year shows that nine persons were killed in this city by electricity. Most of the victims were employes of electric concerns. The same source of information shows that eighty persons were killed by street cars or run down by wagons in this city. This would indicate that of all the dangers to the public, that of electricity is really very small. In view of these facts it is no wonder the merchants of this city are complaining bitterly of the course pursued by the Board of Electrical Control in shutting off their light at a time when it was most needed.

The special commission appointed to test the efficiency of the electrical machines recently purchased by the State for the execution of murderers, visited Auburn Tuesday, killed a calf and an old horse and returned to town perfectly satisfied with their day's work.

The Pearl street station of the Edison company was destroyed by fire Thursday, involving a loss of about $150,000. This plant was the oldest Edison station in the city and the first in the country to use the underground system.

The New Year chimes of 1890 were recorded by two phonographs placed in the belfry tower of Grace Church. One of the cylinders will be preserved in the church while the other will be used at entertainments during the season. The record on the cylinders is excellent, and the reproduction of the tunes comes out clear and strong. W. H. T.

Boston, Mass.

Boston, Mass., January 3.—The new governor of Massachusetts was inaugurated yesterday. In his inaugural address, in pointing out the subjects upon which he deemed legislation desirable, Governor Brackett said: "The report that the Boston fire was caused by an electric wire, and the accidents almost daily occurring from the same cause, admonish us that, while electricity has been made so largely subservient to the uses and conveoiences of civilization, it is adding to the insecurity of life and property. The necessity is urgent for the enactment of laws for the supervision and regulation of electric wires wherever they exist, and for such other carefully matured measures as will, without impairing the use of electricity, lessen the perils attendant thereon." The legislature will doubtless be called upon in various ways this winter to legislate upon matters that are of vital interest and importance to the electrical industries.

Bids for lighting the streets of Boston by means of arc lamps were received by the superintendent of lamps last Saturday in place of those received on Nov. 29, which were reported in the Boston letter at that time. All of those bids were rejected by Mayor Hart on the ground that they were excessive, and a call for new bids not to exceed 40 cents per night per light, has resulted in the following bids: Suburban Light & Power company, for Roxbury for one and three years, $38\frac{99}{100}$ cents, and for five years, $39\frac{74}{100}$ cents; for the city proper, South Boston, West Roxbury and Dorchester for five years, $39\frac{74}{100}$ cents a light per night; Brookline Gas company, Brighton district, for five years, 40 cents a light; Walworth Light & Power company, for the entire city for five years, 40 cents a light per night. The contract has not yet been awarded. The city is at present lighted by the Charlestown Gas company and the Boston Electric Light company, the contract expiring on Jan. 7, but neither of these companies made bids under the 40 cent requirement. Both of them sent in letters stating their inability to comply with the terms and conditions of the proposal. The action of the board of aldermen, in postponing indefinitely at the meeting this week, the order requesting the mayor not to give his approval of any new contracts which shall require the city to pay more than 40 cents per light, indicates a disposition to go slowly in so important a matter.

It is expected that the West End Street Railway company will make an application to the legislature this winter for an elevated railroad charter. President Whitney, of the West End is authority for this statement of the company's intentions, but the exact plans of the undertaking have not yet been made public. Last year the company successfully opposed the plans of all others who sought the right from the legislature to erect overhead structures in the streets because of the many objectionable features of such structures. This expressed intention of the West End company is of interest to electricians because of the company's enthusiastic adoption of electric motors to replace the horses on all surface roads, a step which indicates that, should an elevated road be built, electricity would probably be the motive power for the trains. The fact that the Thomson-Houston Electric company is now building an experimental electric locomotive for the West End company also indicates a desire on the part of the railway company to obtain a motor that will be suitable for the drawing of heavy trains.

The selectmen of Revere have decided that the managers of the Boston & Revere electric railroad must resume the operation of their road at once in order to comply with the conditions of the franchise. This is a summer road and had put up its cars for the season, but the selectmen hold that it must be kept in operation throughout the year.

The Billings & Spencer company at Hartford, Conn., has recently booked an order from the Edison Machine Works for 50,000 Billings' patent drop forged commutator bars. The order will require the use of thirty tons of Lake Superior copper. During the past year the company has supplied over 100 tons of these forgings to dynamo and motor manufacturers in the United States. The Canadian patent office has recently granted Mr. Billings a patent on his invention.

The Robinson-Foster Motor company's works at Peabody, which were recently sold at a mortgagee's sale, were reopened this week under new management for the manufacture of motors and other electrical apparatus.

H. C. Spaulding, the general manager of the Thomson-Houston Motor company, lectured on Thursday evening of this week at Wells Memorial Hall upon "Electric Power." This was one of the lectures in the Lowell Institute course. Photographs of motors operating in various industries were passed around for the inspection of those present.

It is stated in the financial columns of the *Herald* that those who purchased Thomson-Houston stock in the fall of 1888 paid between $80 and $90 per share. The actual cash value of the dividends and rights received by them since that time, has been considerably in excess of $50 per share. When the Thomson-Houston syndicate made the original purchase of the company, the net earnings were about $5 per share on the outstanding stock. While the number of shares has since been largely increased, the current net earnings of the company are about $15 per share on all of the 180,000 shares of common stock. The par value of the shares is $25. O. H. M.

Philadelphia, Pa.

Philadelphia, Jan. 6.—Bids received for lighting the streets of the city by electricity indicate that the several companies have divided the city up into districts, one of which is apportioned to each company, and there is practically no competition in the bids. The companies have, nevertheless, made a slight reduction in their charges. The prices range from 45 to 55 cents per lamp per night. The higher prices are charged in the suburbs where there is little private lighting, and the interest on plant chargeable to the city is therefore greater. The lights are to be kept burning from sunset to sunrise every day in the year. The prices named above are from one to two and a-half cents less per lamp per night than was paid in 1889. The city now pays about $200,000 per annum for electric lighting. A committee of councils is to report next week on the subject of building an electric light plant. It is said that $50,000 per annum could be saved if the city should supply its own lights from stations on the Delaware and Schuylkill water fronts. F.

South Bend, Ind., is lighted by electricity. The *Tribune* of that city says: "The electric company was fortunate in being able to begin its contract for lighting the city on the date fixed upon, the first day of the new year. It is probably the only instance on record where a contractor with the city has not asked for extension of time. Nearly a hundred lights were turned on New Year's night at 6 o'clock, illuminating every part of the city. Forty of these burned until 6 o'clock the next morning. The city electric lighting system is now fairly under way, and the light furnished is a most brilliant one. Four dynamos are in operation, and more are in reserve in case of accident."

THE ELECTRIC LIGHT.

Rochester, Minn., is enjoying electric lights for street illumination.

Seymour, Ind., has contracted for electric lights for public illumination.

Work has been begun on a new incandescent electric light plant at Muscatine, Ia.

The demand for arc lights in Bryan, O., has necessitated an increase in the capacity of the station.

The electric railway at Spokane Falls, Wash., will be illuminated throughout the line by electricity.

A French paper estimates the number of arc lamps in Paris at 900, and incandescent lamps at 63,000.

The electric light company at Independence, Mo., is introducing new machinery and enlarging its plant.

The West Superior, Wis., Electric Light company has increased its capacity by adding a 50 arc light machine.

The Weeping Water Electric Light company was incorporated at Lincoln, Neb., last week, capital stock $30,000.

An English company is about to install an electric light plant in Hammerfest, Norway, the northernmost town of the globe.

The Naperville, Ill., Electric company has been incorporated with a capital stock of $12,000 to operate an electric light plant.

The Evanston, Ill., electric light station is rapidly approaching completion. The boiler is on its foundations, two engines are set up and the dynamo foundations are completed.

The Duluth, Minn., Electric Light company has placed a new 50-light arc dynamo in position at the station. The company's contracts with the city for street lighting will be filled immediately.

The people of Delphos, O., ushered the new year in with a blaze of glory supplied by the new electric light system for illuminating the streets. Everything worked well, and the people are delighted with the new light.

The mayor and city council of Denver, Colo., are engaged in a controversy over supplying the city with electric lights. The aldermen have their own opinions as to the appropriations, plans, etc., while the mayor is equally positive in his opinions.

J. A. Bendure of Ottawa, Kan., is installing for the Pittsburg Gas Light & Coke company of Pittsburg, Kan., a 70 arc light and 750 incandescent light plant; both are Westinghouse machines. The plant will probably be started January 18th.

The city trustees, of Sacramento, Cal., have voted to grant a franchise to C. F. Fargo, L. L Baker, J. D. Redding, H. G. Smith and others to introduce a Westinghouse electric light plant, and have awarded the company a contract to light the streets. The new company agrees to have its plant in operation in ninety days.

Chicago merchants on State street and Archer Ave. have formed an electric light company and hope to have a plant running at an early day to that locality. They intend to illuminate the street in front of their shops as well as the interior of the structures and have adopted the Schuyler system. Archer Ave., from State to Stewart streets, Wentworth Ave. from Archer Ave. to 31st street and all the branch streets will be included in the territory.

The Citizens' Electric Light & Power company of East St. Louis, which has been awarded the contract for lighting the streets of the city, commenced to place poles in position, and expects to have them all up in two weeks. The wires will then be strung, and before the close of the present month the City of East St. Louis will be magnificently illuminated. About 100 lights, it is estimated, will be necessary to properly illuminate the town, and the cost will not exceed the price of poor gas to any alarming extent.

The annual report of the operations of the Allegheny County Electric Light company show that a year ago the number of incandescent lights operated was 20,145; arc lights, 240, and there are at present 27,500 incandescent and 740 arc lights in operation. The present capital is $500,000, and its earning capacity for the last six months was $30,000 net, 12 per cent. In view of the earning power of the capital at present employed and the constantly growing demand for service, it was decided to increase the capital stock to $1,250,000, the prosperity of the company rendering the increase safe in the estimation of the stockholders.

The Thomson-Houston Electric company reports the following sales of arc apparatus to central stations: Lowell, Mass., 25; Rochester, Md., 50; St. John, Mich., 30; Camden, Ark., 30; City of Chicago, Ill., 210; Chicago, Ill., 100; Litchfield, Ill., 50; Fairhaven, Washington, 30; Chattanooga, Tenn., 100; Toledo, O., 50; W. Superior, Wis., 50; Cincinnati, O., 200; Macon, Ga., 100; Pottstown, Pa., 50; Spokane Falls, Wash., 100; Huntington, Pa., 50; Bedford, Md., 50; Long Branch, N. Y., 100; Wilkesbarre, Pa., 50; Austin, Minn., 50; Weymouth, Mass., 60; New Haven, Conn., 50; Missoula, Mont., 50; Cedelia, Mont., 100.

The Westinghouse Electric company secured contracts for alteroating current apparatus during the first three weeks of December for the following central stations: Salem, O., 750 lights; Louisville, Ky., 750 lights; Greenfield, Mass., 750 lights; Denison, O., 500 lights; St. Louis, Mo., 2,500 lights; Hamilton, Ont., 1,500 lights; Denver, Col., 3,000 lights; Pittsburg, Kan., 750 lights; Pueblo, Col., 750 lights; McKinney, Tex., 500 lights; Portland, Ore., 6,000 lights; Lynchburg, Va., 750 lights; Dansville, N. Y., 500 lights; Batavia, N. Y., 750 lights; Pittsburgh, Pa., 3,000 lights; Oldtown, Me., 750 lights. Arc light machines of a capacity of 250 lamps were sold to Pittsburgh, Kan., 50; Portland, Ore., 100, New Bedford, Mass., 100.

The Thomson-Houston Electric company reports the following sales of incandescent apparatus to central stations: Sioux Falls, So. Dakota, 50 lights; Tuscumbia, Ala., 100 lights; Mays Landing, N. Y., 400 lights; Portland, Me., 800 lights; St. John, Mich., 500 lights; Boston, Mass., 500 lights; Adams, Mass., 500 lights; Middleboro, Ky., 500 lights; Seymour, Conn., 500 lights; Langhorn, Pa., 500 lights; Plymouth, Mass., 500 lights; E. Greenwich, R. I., 850 lights; Oswego, N. Y., 1,300 lights; Hyde Park, Mass., 1 300 lights; Andover, Mass., 650 lights; Winchester, Md., 650 lights; Somerset, Ky., 650 lights; Watertown, N. Y., 650 lights; Catskill, N. Y., 650 lights; Rochester, N. Y., 650 lights; Huntington, Pa., 650 lights.

The Thomson-Houston Electric company reports the following sales of arc and incandescent apparatus for isolated plants: Arc—Allentown Rolling Mill, Allentown, Pa., 18; L. F. Bartlett, E. Saginaw, Mich., 18; Pioneer Mining & Manufacturing Co., Thomas, Ala., 37; Merrimac Manufacturing Co., Lowell, Mass., 45; G. F. Blakeman & Co., E. Cambridge, Mass., 30. Incandescent—E. A. Gyde, E. Saginaw, Mich., 35; National Transit Co., Kane, Pa., 100; National Transit Co., Parker Landing, Pa., 100; Waterworks Building, Detroit, Mich., 100; St. Clair Hotel, Cincinnati, O., 100; Louisville Chair Co., Louisville, Ky., 200; J. O. Shoup & Co., Dayton, O., 1,600; Norfolk Woolen Co., Norfolk, Mass., 50; Wadsworth, Howland & Co., Malden, Mass., 50; J. W. Ayer, Brewer Village, Me., 50; Allentown Rolling Mill, Allentown, Pa., 200; White Cycle Co., Westboro, Mass., 100; Midgely Wire Belt Co., Beaver Falls, Pa., 100; Locke Bros., Salem, Mass., 200; Woodrough & McFarlan, Cincinnati, O., 200; H. A. Marston, So. Framingham, Mass., 200; Eastern Manufacturing Co., Brewer, Me., 200.

THE ELECTRIC MOTOR.

March 15th is the appointed time for opening the new electric railway at Covington, Ky.

Traffic on the electric road at Minneapolis, Minn., is so great that already it has been found necessary to order new cars.

The work of equipping the Union Passenger Railway at Richmond, Va., with Sprague motors of the latest type, is now in progress.

Electric cars for the Crescent City Railroad company, New Orleans, La., are being constructed, and the line will soon be in operation.

The taxpayers of Rock Island, Ill., want an electric railroad and are endeavoring to secure the extension of the Central Street railway of Moline to the business center of Rock Island.

After considerable argument between the electric railway management and the city council, the Hutchinson, Kan., Street Car company has decided to place poles for its electric system in the center of the street.

The management of the Beaver Falls College & Metamora Electric Railway company, of Beaver Falls, Pa., has decided to adopt the Thomson-Houston electric system. Work will be commenced early in the spring.

The Cincinnati, O., aldermen are considering a franchise enabling the South Covington & Cincinnati Street Railway company to substitute electricity for animal power. The Board of Public Works has recommended its passage.

The Thomson-Houston company is building electric locomotives for the West End Street Railway company, of Boston, capable of drawing a long train of cars and on these the motors will probably have a different position.

With the completion of the Sixteenth street motor line at Omaha, Neb., the extension of the electric lines in that city will cease for the winter. The season just closed has been a prosperous one for electric roads in Omaha and Council Bluffs.

Pueblo, Colo., citizens are not satisfied with horse cars and they are anxious to have the local street railway company introduce an electric system. Should the company fail to do so another railway company will be formed to build an electric road.

The Robinson Electric Street Railway company of Toledo, O., and the telephone and telegraph companies doing business in that city have engaged in a legal warfare over the respective merits of the several litigants to string wires in the streets of Toledo.

John Weber of Des Moines, Ia., who purchased the Atchison, Kan., Street Railroad company's plant, has taken possession and is preparing to introduce an electric system. A power house will be erected at once, and the contract for the electrical equipment awarded.

The Bangor, Me., Electric Railroad company is about to move its plant to Veazie, and will use water power instead of steam. It is the intention of the management to extend the line considerably during the coming season, and to make additions to the rolling stock.

The River and Rail company of New York, will construct and operate an electric road at Denver, Colo., and promises to have it running next summer. This company has a storage battery system which is highly commended by leading electrical experts who have tested it.

The storage battery cars used on the new electric railway between Beverly and Danvers are said to be running without a hitch of any kind. The road is by no means a level or straight one, but the cars are run at a good rate of speed. Each set, so it is claimed, will run a car forty miles with a single charge. The batteries are charged by means of a 36-horse-power engine, and the time occupied for the double equipment of six cars is only eight hours.

The Short Electric Railway company, of Cleveland, O., has secured the contract for the two divisions of the South Covington & Cincinnati Street Railway company, eight miles in length, with an original equipment of ten cars. Work on the overhead construction has begun, and the road will be in operation in a few weeks.

F. J. Baker, manager of the Chicago office of the Daft Electric company, has recently installed a 7-horse power motor in the printing office of Geo. E. Cole & Co., Chicago. Besides running the printing office the motor supplies power to run the freight elevator. Notwithstanding the fact that Mr. Cole has a 40-horse power engine and a 50-horse power boiler in his basement, he has found that he has effected a saving of $20 per month by using the motor.

The following from a Boston paper will prove interesting to those who have never seen an electric car during a snowstorm: "The writer had occasion to be out at night for as much as an hour in the worst of the blizzard. For ten minutes at least he stood in Copley square watching the electric cars go by in a rapidly moving string, through the driving snow and over the encumbered tracks. It was simply a procession of fiery chariots. From the rear wheels the fire flew out in each direction. Up on the trolley wire there were frequent discharges of fire, accompanied with a ringing sound—'ping, ping!' The greenish light from all these discharges intermittently illuminated the facades of the magnificent buildings in the square like flashes of lightning, though the full glare of the light was softened a little by the masses of falling snow. It was a weird spectacle, surely. The writer is told that the fiery discharges along the track when the cars pass over the snow is due to the slight lifting of the wheel from the rail by the snow, and that this separation of the two metallic surfaces produces an arc, as in the electric arc light. But whatever may be the cause, the effect is decidedly picturesque, though not to say alluring."

The citizens of Denver, Colo., are pleased with the operation of the new electric line in that city. A local paper says: "Denver's first electric street railway is a demonstrated success. It will be the forerunner of the adoption of the electric overhead system upon every thoroughfare and to every suburb where already rapid transit is not afforded, and will pay. It is faster, safer and more easily regulated than the cable; and it is less noisy and more comfortable in every respect. A car can be run at two, five, ten, or twenty miles an hour. It can be stopped instantly. It can be reversed. The tramway electric road was practically tested yesterday. A motor car, loaded with passengers, ran the round trip of the line twice, or, in all, sixteen miles. The car was well filled with invited guests on each trip. The result of the test was that every passenger was delighted. The speed of twenty miles an hour was attained, and at the will of the driver the car moved at scarcely a snail's pace. It stopped and started without jar or jerk. It made less than half as much noise as a cable car. A single car will run rapidly with one motor, and two trail cars can be carried at twenty miles an hour with two motors. One or both can be used at the will of the driver."

THE TELEPHONE.

Fire was discovered in the janitor's room of the Chicago Telephone company's building Saturday morning. It was extinguished before much damage was done.

The rate war promises to break out afresh in Kansas City, Mo., where it is claimed the city has authority over the telephone company, though that corporation is organized under the state, and not the municipal law.

Miscellaneous Notes.

The Citizens' Electric Supply company has been organized at East St Louis, to manufacture electrical apparatus and supplies; capital stock, $1,000; incorporators, H. D. Sexton, I. B. Sager, and Martin D. Baker.

The killing of a couple of horses by electricity, Christmas, at Pittsburg, Pa., has created quite a stir in that city. All dead wires are being removed by order of the city council, and a careful inspection of live wires has been ordered.

John Morrill, the veteran base ball player, who is now on the Pacific coast writes as follows concerning an electrical device which it is proposed to introduce into the game: "In our game yesterday we tried the new first base bag. It is made of rubber with an electrical attachment, and the minute the runner or fielder touches it a bell rings in the grand stand. With the hope that it will assist the scorer or reporter in deciding whether the umpire's decisions on close plays are correct, I am satisfied that it will not accomplish the desired result, and there is nothing that can be invented that will be an improvement on the old canvas bag." The inventor of this device evidently had little regard for the life, health or safety of the umpire.

A Cleveland paper says: Copper magnates now boast that in a short time prices of copper will be as high as they were under the influence of the exploded French syndicate. This simply means that a new syndicate is getting in its work, that a new combination is organized with European producers to maintain extravagantly high prices. This movement is not, like a protective tariff, in the interest of the American working men. It is purely for the benefit of the stockholders of copper mines. Such a combination, pervading the entire world, leaves no room for the freedom of competition to regulate prices. The Calumet and Hecla, Tamarack, Quincy, Osceola, Atlantic, Franklin, Huron, Kearsage, and Peninsula, nine great copper companies, each send a representative to confer with the repre-

sentatives of European companies and up go the prices of copper all over the world. The companies above named produced 45,601 tons of copper during the first ten months of 1889. The wages paid to their men were already established by the influence of the protective tariff. The profits were certainly high enough. It is a well-known fact that more than one of the above named companies can sell copper at 8 cents per pound, and make a fair profit. They want 15, 16 and 17 cents per pound, and to get it they do not look to the tariff, but seek the protection of a combination with European millionaires, to force up prices to American consumers. The moment American producers unite with Europeans to extort extravagant prices from American consumers, that moment they forfeit all claim to protection from our government.

A new fog signaling apparatus has lately been perfected in England which is of sufficient merit to attract the attention of all those interested in the saving of life and property at sea, says the New York *Herald*. It calls into use electricity, which admits of the signals being automatically worked and at the same time records every signal as it is given on a band of graduated paper This paper forms a complete register of the signals, and is documentary evidence in case of dispute as to whether or not a vessel was signaling when a collision occurred. The apparatus consists of a single switch which is placed on the vessel's bridge so that the signaling can be controlled by the officer on watch. When it is desired to blow the signal whistle or begin the automatic signaling, whatever its nature may be, the lever is turned to the "under way" notch if the vessel be moving, and the electric current at once begins working the valve of the steam whistle at regular intervals, conforming to what the law specifies. Should the vessel be at anchor the switch is turned to "at anchor," and the bell is rung in the same way. The register consists of the band of paper properly subdivided and moved along by clock work. A traveling pointer, actuated by an electro-magnet, pricks the paper at every sound of the bell or whistle. The signaling can also be made at will entirely independent of automatic mechanism by simply pressing a button which closes the circuit leading to the bell or whistle.

Personal Mention.

G. H. Gale of the Detroit Storage Battery company was in Chicago last week.

William S. Turner, of Woodbridge & Turner, New York, visited Chicago last week.

John G. Boyd, representing the Queen City Electric company, Cincinnati, O., paid a brief visit to Chicago last week.

T. P. Conant, superintendent of construction for the United Edison company, New York, was in Chicago last week.

Business Mention.

The Cleverly Electrical company of 1018 Chestnut street, Phila., has just issued an unusually handsome calendar for 1890.

Pettingell, Andrews & Co. of 192–196 Summer St., Boston, are circulating with their compliments, a large office calendar for 1890.

F. E. Degenhardt, Western manager of the Standard Underground Cable company, has moved his office to 542 Rookery Building, Chicago

The sales of the Westinghouse Machine company of Pittsburg, for October, 1889 amounted to 109 engines, aggregating 5,940-horse power. The orders for November, however were the heaviest in the history of the company. During this month 104 engines were sold, aggregating 7,180-horse power.

W. B. Pearson hereafter will represent the Ball Engine company in Chicago, with office at 403 Home Insurance building. His territory will include Illinois, Iowa, Northern Indiana, Wisconsin and Michigan, to the east shore. Mr. Pearson is favorably known to engine buyers in Chicago and surrounding territory, and the large and growing business of the Ball Engine company will no doubt, be still further extended under his management.

The Duluth, Minn., Electric Light & Power company has enjoyed a prosperous year and added to its plant two 750 incandescent dynamos of the Westinghouse alternating current system, purchased the lot and building where it first located on Michigan street, thus doubling the amount of real estate owned by the company; increased its steam appliance by the erection of a large brick stack and by the purchase of another 175 horse power engine and a 500-horse power boiler of the Scotch marine type. In the prosecution of its business for the year, it has paid for labor and construction nearly $60,000, and has wired seven of the finest business buildings in the city, including Temple Opera and a large number of the most costly private residences; has more than doubled its capacity and is still far behind its orders for new work, being unable to secure a sufficient supply of material and skilled labor for the rapidly increasing demand for its service.

The Marr Construction company, the Keystone Construction company and the Washington Carbon company, of Pittsburgh, Pa., have become consolidated under the name of the North American Construction company. This organization will be one of the strongest concerns in the country. In addition to the construction work it will continue the manufacture of carbons, increasing the present facilities. Electrical supplies of all kind will be manufactured and a specialty of this class of work will be made. The headquarters of the consolidated concern will be at Pittsburgh, Pa., and the business throughout the country will be conducted for a time at least, through the same offices as heretofore. Frank S. Marr will probably be president of the new concern, and E. W. Wells, general manager. The Western department with headquarters at Chicago, will be under the management of E. F. Keller. It is expected that by combining these three great important concerns one of the strongest corporations of that class in the country will be secured. The new concern will be identified closely with the Westinghouse interests.

Electrical Patents.

Issued Dec. 31, 1889.

418,198. Method of Making Collars on Axles by Electricity. Hermann Lemp and Elihu Thomson, Lynn, Mass.

418,208. Insulating and Waterproofing Composition. Anthony E. Menuez, Minneapolis, Minn.

418,227. Electric Exercising Machine. Edward W. Robinson, Boston, Mass.

418,248. Electric Magnetic Motor. Nikola Tesla, New York, N. Y.

At the start the magnetic poles of one element or field of the motor are progressively shifted by alternating currents differing in phase, and passed through independent energizing circuits while the coils of the other element are short-circuited. When the motor thus started reaches or passes the limit of speed synchronous with the generator, the coils, previously short-circuited, are connected up with a source of direct current and by a change of the circuit connections producing a simple alternation of the poles. The motor then continues to run in synchronism with the generator.

The first claim reads:

"The method of operating electro-magnetic motors, which consists in first progressively shifting or rotating the magnetic poles of one element until it has reached a synchronous speed, and then alternating said poles and passing a direct current through the coils of the other element."

418,249. Lightning Arrester. Elihu Thomson, Lynn, Mass.

The claim follows:

"The combination, with an electric circuit and a branch or ground from the same containing electrodes placed in close proximity but separated from one another, of a circuit breaker in the said circuit and an electro magnet or other responsive device in the ground branch for controlling said circuit-breaker."

418,258. Electric Railway Signal. Edgar C. Wiley, Independence, Va.

418,270. Combined Gas and Electric Light Fixture. David J. Braun, Chicago, Ill.

The object of the invention is to have a combined gas and electric light cock of such a character that the electric light wires will be entirely concealed, but at the same time readily accessible without the necessity for disconnecting the gas fixtures or cock, or changing the appearance from an ordinary gas stop cock.

418,284. Quadruplex Telegraphy. Clarence L. Healy, Brooklyn, N. Y.

418,301. Armature for Dynamos. James J. Wood, Brooklyn, N. Y.

418,302. Automatic Regulator for Dynamo-Electric Machines. James J. Wood, Brooklyn, N. Y.

The last claim is given:

"12. In a current-regulator operating by the shifting of the commutator brushes, the combination with the brushes, of a friction wheel connected to them so that its rotary movement shall shift them, two oppositely revolving friction rollers movable into and out of contact with said wheel, an electromotive device responding to changes in the circuit and connected to said rollers, whereby by its movement in one direction or the other, one or the other of said rollers is moved into driving contact with said wheel, and a bearing for said wheel movable toward and from said rollers, whereby the relative positions of the wheel and rollers may be adjusted."

418,303. Current Regulator for Dynamo Electric Machines. James J. Wood, Brooklyn, N. Y.

Of the twenty claims the nineteenth is given:

"In a current regulator operating by the shifting of the collecting brushes on the commutator, the combination, with an automatic current regulator comprising a shifting mechanism having differential driving pinions, of the main commutator brushes and their carrier connected to and driven by the larger of said pinions, and supplemental brushes and a carrier therefor connected to and driven by the smaller of said pinions, whereby the movement of the shifting mechanism communicates differential movements to the respective pairs of brushes causing the main and supplemental brushes to relatively approach each other when moving from and separate from each other in moving toward the position of maximum current."

418,321. Type-Setting Machine. John B. Odell, Chicago, Ill.

418,322. Electric Signal System for Letter-Boxes. Geo. L. B. Rounseville, Chicago, Ill.

A number of letter boxes are electrically connected with a central station to establish communication between each of said boxes and said station. Letter boxes thus connected to a central station are provided with automatic means whereby, when the box is opened, the number of the box will be announced and registered at the central station, said announcing and registering taking place automatically, and being beyond the control of the person opening or attempting to open the box.

418,360. Screw-Cleat for Electric Wires. George E. Huff, Hartford, Conn.

418,373. Electric Railway. Hosea W. Libbey, Boston, Mass.

418,391. Passenger Recorder for Railway Cars. Addison C. Stone, Chicago, Ill.

418,402. Electric Brake Mechanism for Cars. William H. Darling, New York, N. Y.

418,426. Incandescent Electric Lamp Socket. Frank Thone, Oskaloosa, Iowa.

418,443. Mechanical Telegraph Instrument. Jesse H. Bunnell, New York, N. Y.

418,444. Electric Arc Lamp. Jesse H. Bunnell, New York, N. Y.

The claim reads:

"In an arc lamp, the combination of an electro-magnet and armature for striking the arc, and an independent differential electro-magnet system for effecting the feed, one magnet of said system being in series with the carbons and the arc striking magnet, and the other magnet of said system being in shunt around the arc, but in series with the arc striking magnet."

418,472. Electric Meter. Charles A. Pratt, Toledo, Ohio.

418,474. Electric Light Carbon. Llewellyn Saunderson, Kingstown County of Dublin, Ireland.

418,483. Secondary Battery. Albert E. Woolf, New York, N. Y.

418,484. Perforating Machine, Frank Anderson, Peekskill, N. Y.

418,510. Method of Finding the Positions of Distant Objects. Bradley A. Fiske, U. S. Navy.

418,550. Apparatus for the Manufacture of Gas Martin C. Burt, Lake View, Ill.

The claim reads:

"In an apparatus for the manufacture of gas for illuminating or heating purposes, the combination of a vessel for holding the liquid from which the gas is made, a retort mounted on a movable frame, a means for causing it to be alternately immersed and removed from the liquid, a generator of electricity connected by wires with the framework and retort, and a means for forming and breaking the electric circuit, whereby the retort as it emerges is heated sufficiently to convert the liquid carried up by it into a fixed or permanent gas."

418,551. Apparatus for the Manufacture of Gas by Electricity. Martin C. Burt, Lake View, Ill.

418,559. Electric Meter. Alphonse J. Frager, Paris, France.

The electric meter comprises the combination of the following instrumentalities: First, an electro dynamometer, which indicates at each instant the electrical energy expended per second; second, a clock work, which measures time and marks off the intervals at which the energy is counted up; third, a registering apparatus, which carries into effect the product of the first two quantities and indicates on dials the total energy consumed.

418,560. Bell. Edward Frost, Littleton, Mass.

418,602. Governor for Steam Engines. Louis Bell and William H. P. Creighton, Lafayette, Ind.

418,636. Electric Light Fixture. George C. Baillard, New York, N. Y.

418,652. Generation and Distribution of Electric Currents. Francis J. Patten, New York, N. Y.

Claim 5 is given:

"An alternating current transformer having two primary inducing circuits connected to separate leads, which conveys, respectively, the opposite impulses of the same alternating current."

418,653. System of Electrical Distribution. Francis J. Patten, New York, N. Y.

Claim 4 reads:

"The method of producing and regulating arc lights which consists in sending alternating currents through the carbon points of the arc lights, and the positive and negative impulses of the same current inversely through circuits controlling the regulating mechanism."

418,654. Electric Motor. Francis J. Patten, New York, N. Y.

Claim 1 follows:

"The method of operating electric motors which consists in producing the constant magnetization of one element by sending through separate windings on said element the opposite impulses of an alternating current in opposite directions, and in giving to the other element an alternating polarity by sending through its windings an alternating current."

418,655. Distribution of Electric Currents. Francis J. Patten, New York, N. Y.

Claim 4 reads:

"The method of charging storage batteries by means of an alternating current, which consists in carrying to a middle point of a storage battery an alternating current, and in conveying to the opposite poles, respectively, the positive and negative impulses of the same current."

418,659. Dynamo Electric Generator. William Stanley, Jr., Great Barrington, Mass.

The method consists in opposing the magnetic potential of the field magnet by an alternating counter magnetic potential of the armature in effective value approximately equal to the field magnet potential and varying the opposing effect of such counter-magnetic potential by varying the position of its phases with reference to the field magnet poles by variations in the current flowing.

418,662. Process of Electroplating Dental Plates. Joseph G. Ward, Newark, N. J.

418,664. Electro-Magnetic Type Setting Machine. Wilhelm Dreyer, Frankfort-on the-Main, Prussia, Germany.

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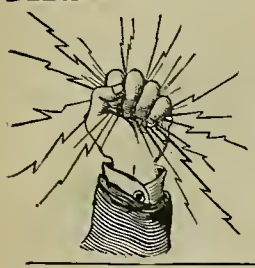

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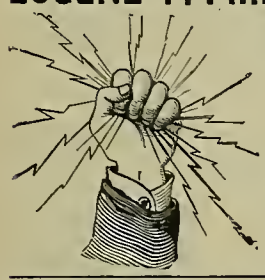

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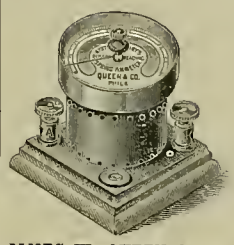

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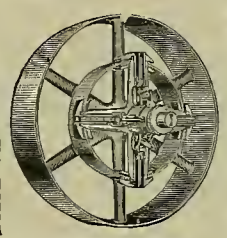

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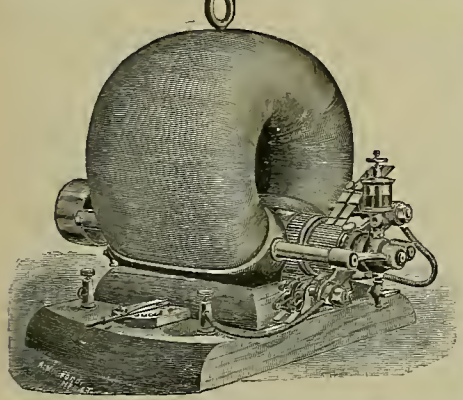

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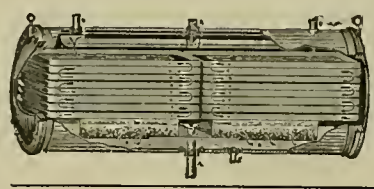

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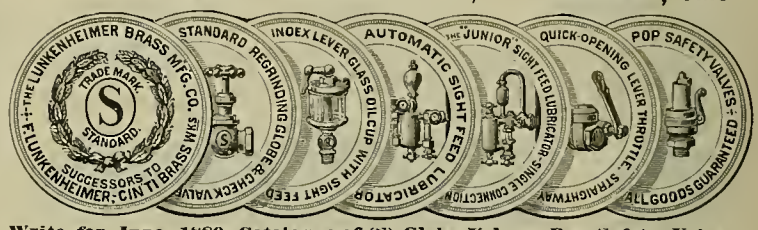

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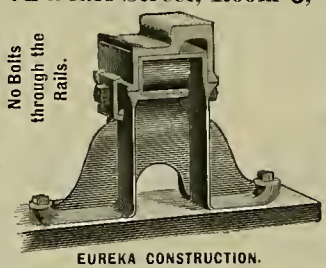

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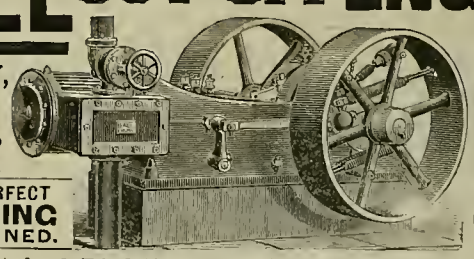

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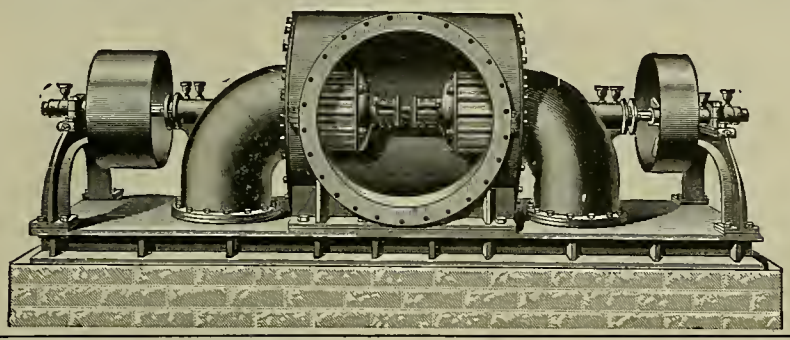

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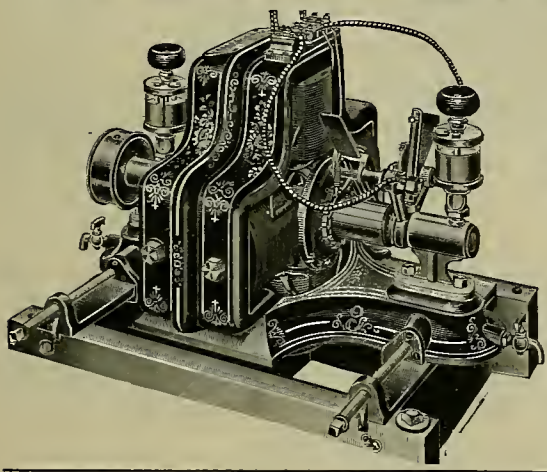

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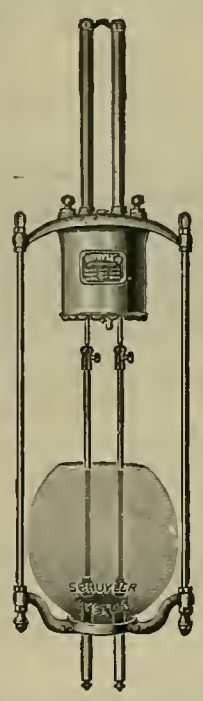

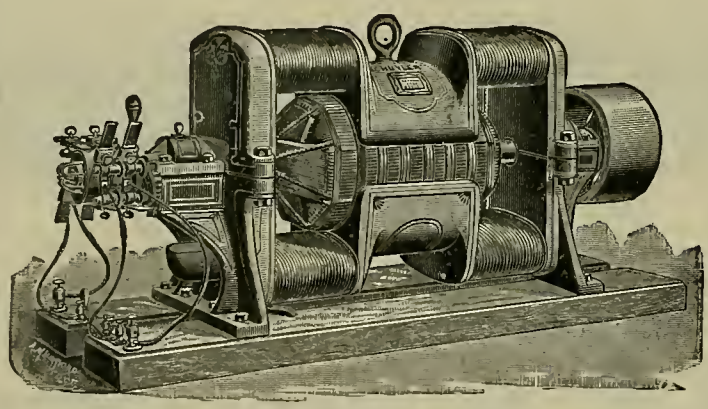

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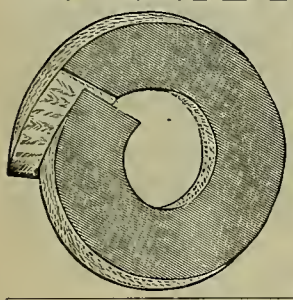

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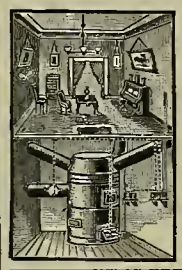

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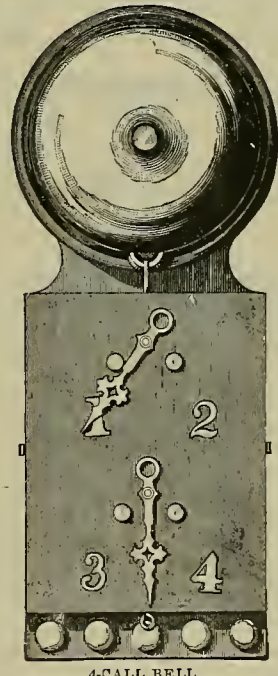

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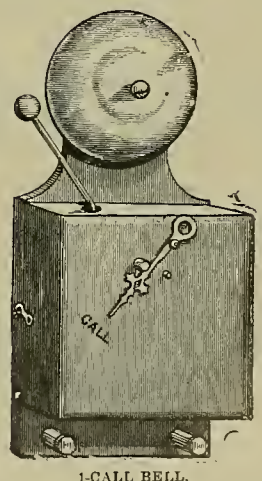

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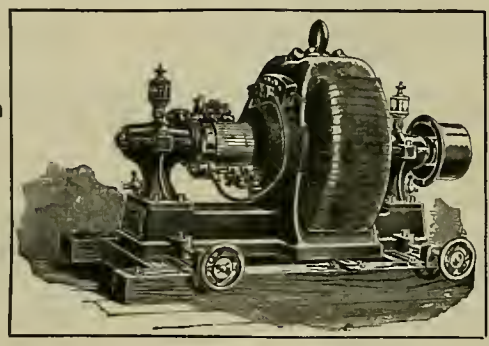

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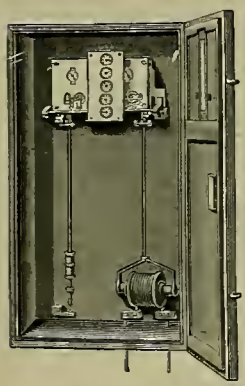

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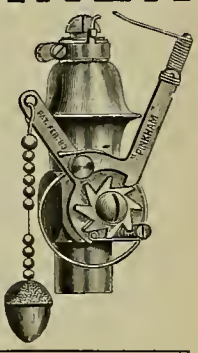

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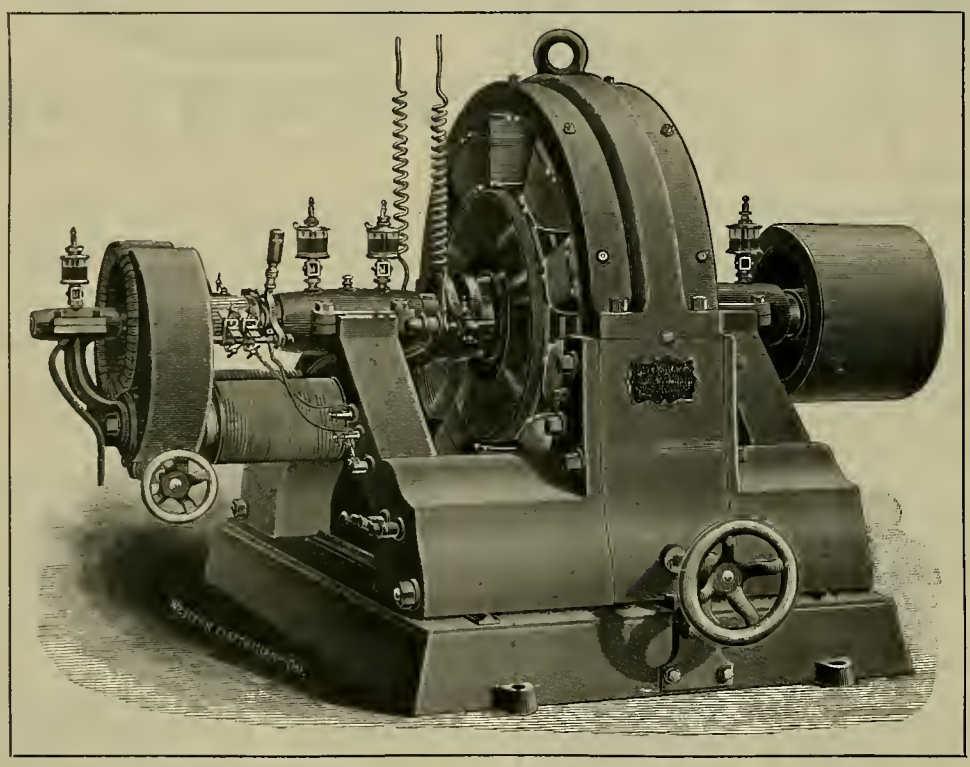

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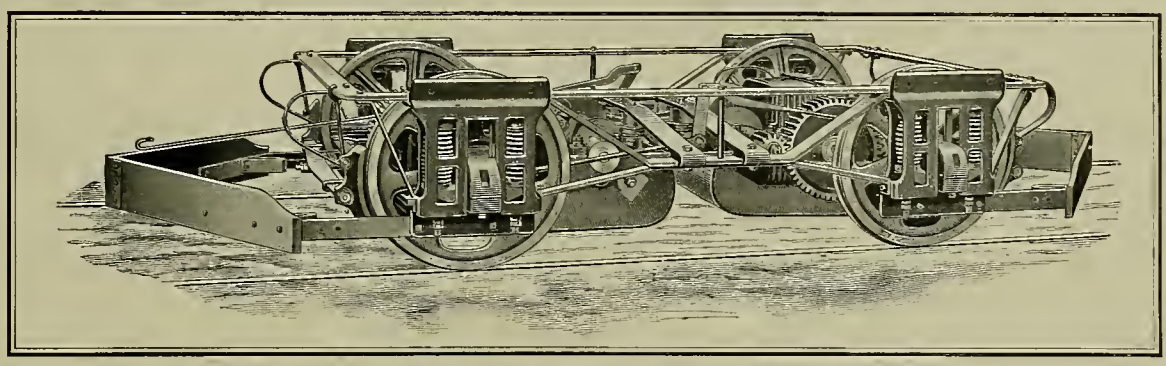

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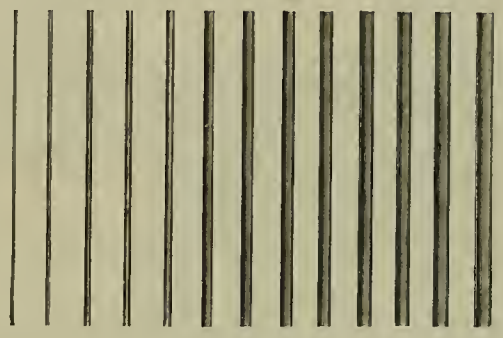

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1301	1	2	2.5	1	1	2	1	1.90
1302	2	4	4.4	2	2	4	2	2.00
1302½	2½	5	5.5	2	3	5	3	2.05
1303	3	5.4	6.2	3	4	6	4	2.10
1304	4	7	8	4	5	8	5	2.25
1305	5	8.3	10	5	6	10	6	2.50
1306	6	10	12	6	7	12	8	3.00
1307	7	11	14	7	9	14	9	3.50
1308	8	12	15	8	10	16	10	4.00
1309	9	13.2	17	9	11	18	12	4.50
1310	10	15	18 5	10	12	20	13	5.00
1312	12	18	21	12	15	24	16	6.00
1314	14	21	24	14	17	28	19	7.00
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IMPORTANT.

BRUSH PATENT SUSTAINED.

The broad right to the use of Double Carbon Electric Arc Lamps declared to belong to the Brush Electric Company, under U. S. Letters Patent to Charles F. Brush, No. 219,208.

In the suit of The Brush Electric Company vs. The Fort Wayne Electric Light Company, decided at Indianapolis, Dec. 24, 1889,

JUDGE GRESHAM HOLDS:

1 *That Brush was the Pioneer Inventor in Commercial Arc Lighting.*

2 *That the Brush Patent in suit is the Pioneer Patent for Double Carbon Arc Lamps.*

3 *That the Patent is Broad and Fundamental.*

4 *That all its Claims (six in number) are valid.*

5 *That the claims of the Patent are all infringed by the Defendant.*

The Court says: "The separation of the two pair of Carbons, so that the Arc is established between one pair and maintained between the Carbons of that pair until they have been consumed and then automatically established between the Carbons of the other pair and maintained between them until they have been consumed, is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the Lamp in suit from all prior lamps."

The Brush Electric Company is assured by the most competent legal advisers that under this Brush Patent, as interpreted by the U. S. Circuit Court, practically all Double Carbon Electric Arc Lamps now offered for sale are

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and notice is hereby given that Infringers, whether manufacturers or users, will be prosecuted and held for damages to the full extent of the Law.

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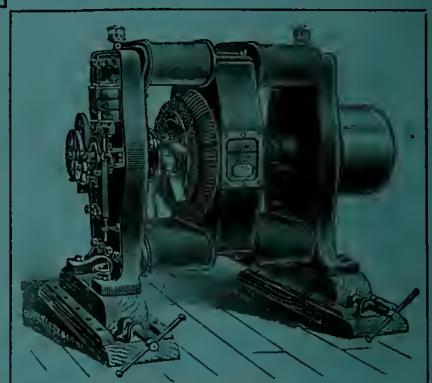

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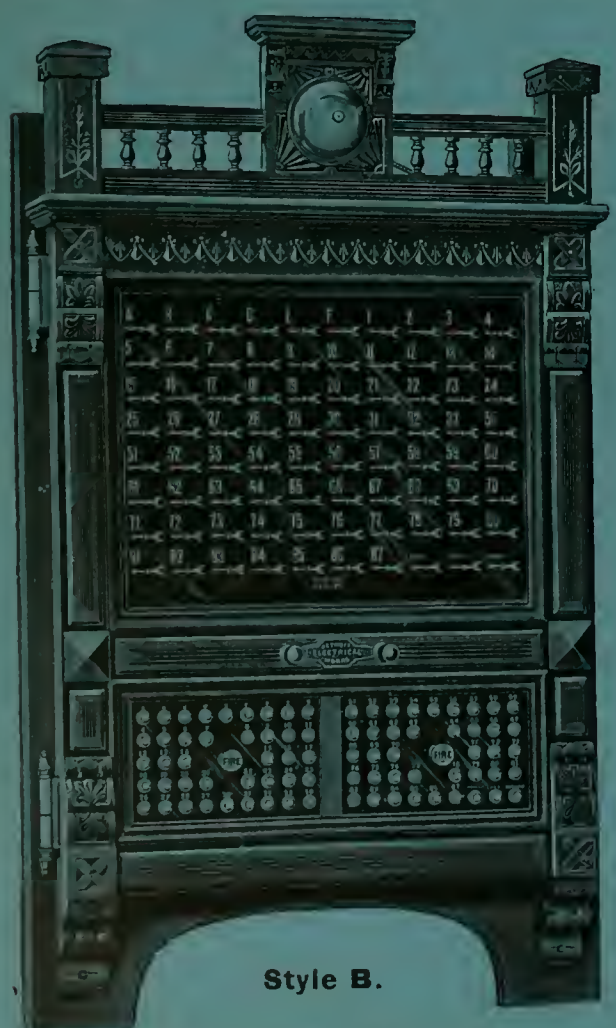

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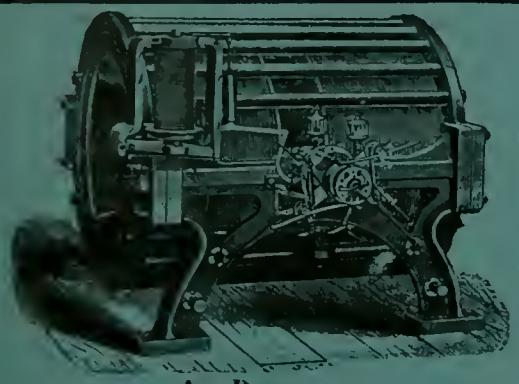

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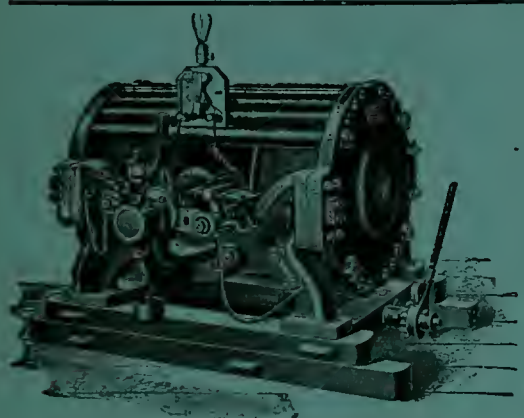

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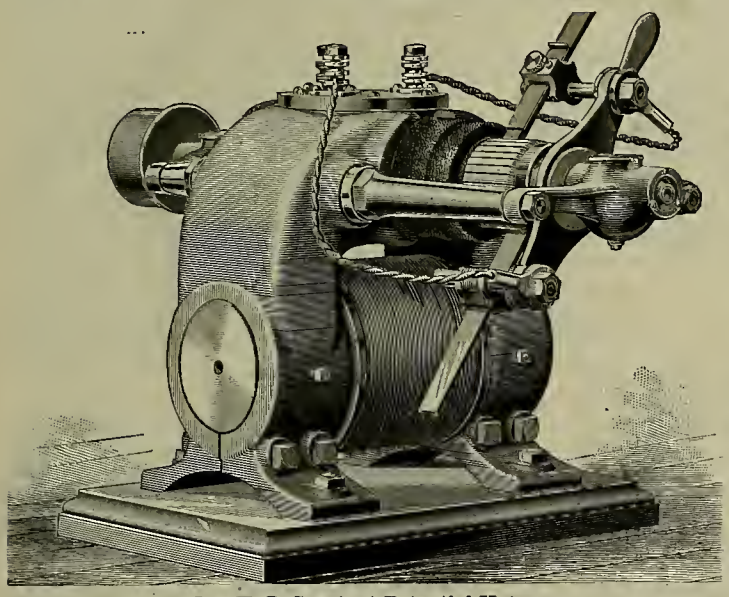

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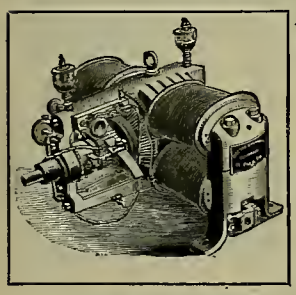

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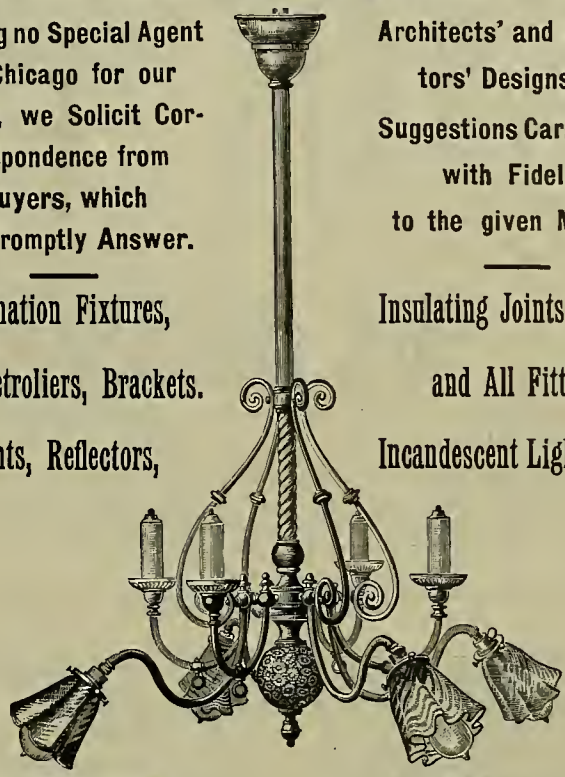

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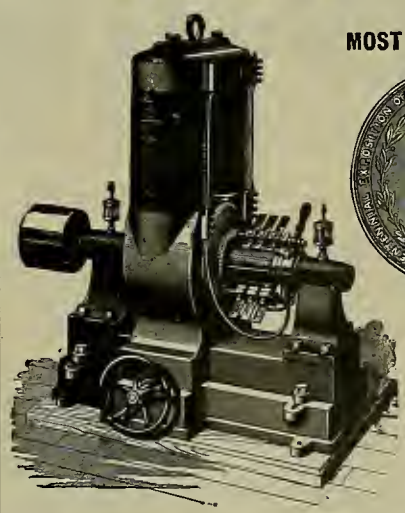

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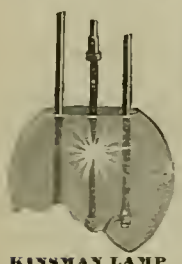

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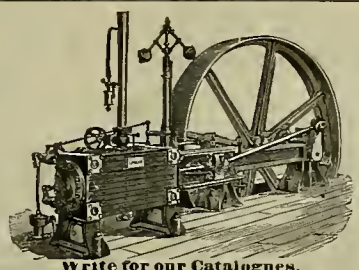

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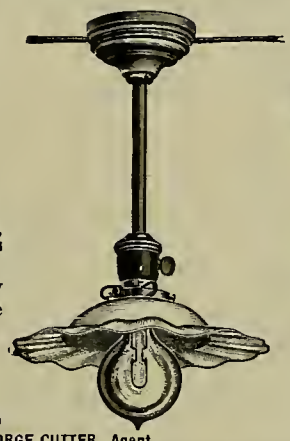

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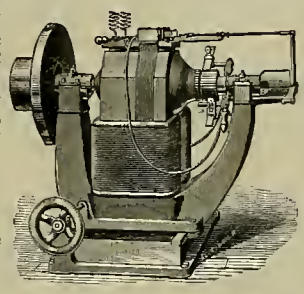

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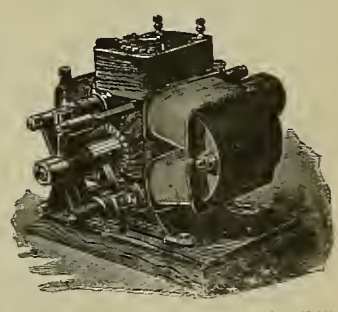

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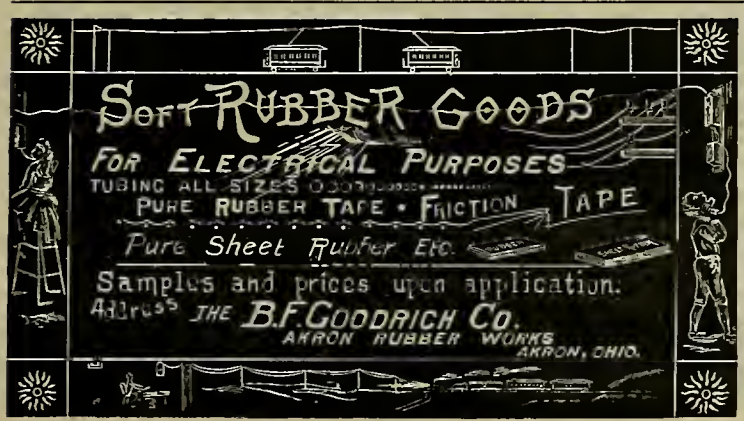

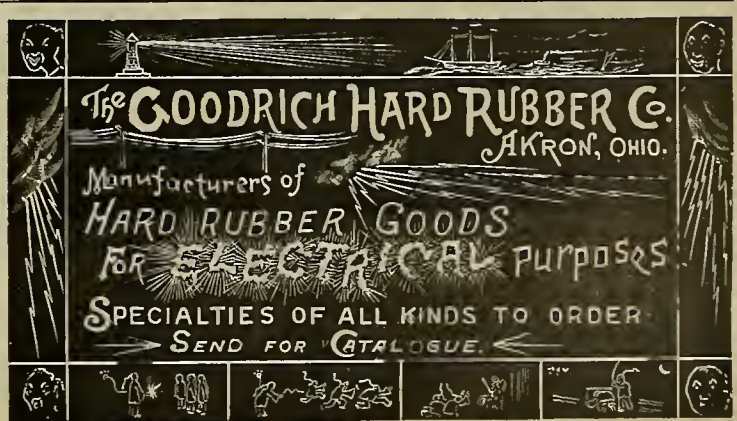

THE BEGINNING OF THE END.

EDISON COMPANY SUSTAINED.

WESTINGHOUSE COMPANY DEFEATED.

Sawyer-Man Patent Decided by the Court to be a Fraud and Absolutely Valueless.

EXTRACTS FROM THE DECISION OF JUSTICE BRADLEY, OCTOBER 5, 1889.

Circuit Court of the United States,
For the Western District of Pennsylvania.

THE CONSOLIDATED ELECTRIC LIGHT COMPANY (Westinghouse Company),

VS.

McKEESPORT LIGHT COMPANY (Edison Company.)

No. 5 May Term, 1888.

ON BILL AND FINAL HEARING.

OPINION OF THE COURT.

BRADLEY, Circuit Justice:

....."The great question in this suit is, whether the patent sued on is valid, so far as involves a general claim for the use in electric lamps of incandescing carbon conductors, made of fibrous or textile substances. If it is, the complainant must prevail. If it is not, the bill 'must be dismissed.' "

....."Is the patent valid for such a broad claim? The defendants contend that it is not. First, because no such invention was set forth in the original application, but was introduced more than four years after it was filed, and after the same material had been used by Edison and claimed by him in application for a patent. Secondly, because Edison, and not Sawyer-Man, was really the original and first inventor of an incandescent conductor made of fibrous or textile material for an electric lamp."

....."It is very clear to us that in the original application for the patent sued on, the applicants had no such object in view as that of claiming all carbon made from fibrous and textile substances as a conductor for an incandescing electric lamp. Nothing on which to base any such claim is disclosed in the original application; we have carefully compared it with the amended application on which the patent was issued, and are fully satisfied that after Edison's inventions on this subject had been published to the world there was an entire change of base on the part of Sawyer & Man, and that the application was amended to give it an entirely different direction and purpose from what it had in its original form."

....."By an adroit amendment made in 1885, they say, 'Our improvement relates more especially to the incandescing conductor, **its substance**, its form, and its combination with the other elements composing the lamp.' The purpose of this amendment is obvious and needs no comment."

....."The fact is that Sawyer & Man were unconscious that the arc was not new, and supposed that they could get a patent for it; but as their eyes were opened, they changed about and amended their application, and made the material of the conductor the great object — carbon made from fibrous and textile material. Compare the original with the amended application, as first stated in this opinion, and this purpose most obviously appears."

....."The fact that the whole object of the application was changed, is evinced by the correspondence of the parties."

....."This testimony of Mr. Broadnax, which is undoubtedly to be relied on, in connection with the letter just quoted, shows that the idea of claiming carbons made from fibrous and textile materials was an after-thought, and was no part of the purpose of the original application. The amendments relating to this new and broad claim were made afterwards, in February and March, 1885.

"We are of the opinion that the changes made in the application in this regard were not justifiable, and that the claim in question cannot be sustained."

....."We are not at all satisfied that **Sawyer & Man** ever made and reduced to practical operation any such invention as is set forth and claimed in the patent in suit. Their principal experiments were made in 1878, and perhaps the beginning of 1879. The evidence as to what they accomplished in the construction of electric lamps is so contradictory and suspicious that we can with difficulty give credence to the conclusions sought to be drawn from it. **We are not satisfied that they ever produced an electric lamp with a burner of carbon made from fibrous material or any other material which was a success."**

....."**The application for the patent in suit was not made until January, 1880, nearly or quite a year after all their experiments had ceased, and after the inventions of Edison had been published to the world."**

....."**The explanations made by the complainants for the delay in applying for the patent in suit, fail to satisfy our minds that Sawyer & Man, or their assignees for them, have not sought to obtain a patent to which they were not legitimately entitled.**

"But suppose it to be true, as the supposed inventors and some of the other witnesses testify, that they did in 1878, construct some lamps with burners of carbon made of fibrous material and of an arched shape, which continued to give light for days or weeks, or months; still, were they a successful invention? Would any one purchase or touch them now? Did they not lack an essential ingredient which was necessary to their adoption and use? Did they go any further in principle, if they did in degree, than did other lamps which had been constructed before? It seems to us that they were following a wrong principle—the principle of small resistance in an incandescing conductor, and a strong current of electricity; and that **the great discovery in the art was that of adopting high resistance in the conductor with a small illuminating surface and a corresponding diminution in the strength of the current. This was accomplished by Edison in his filamental thread like conductors, rendered practicable by the perfection of the vacuum in the globe of the lamp.** He abandoned the old method of making the globe in separate pieces, cemented together, and adopted a globe of one entire piece of glass, into which he introduced small platinum conductors, fastened by fusion of the glass around them, thus being able to procure and maintain perhaps the most perfect vacuum known in the arts. In such a vacuum the slender filaments of carbon attenuated to the last degree of fineness, may be maintained in a state of incandescence without deterioration, for an indefinite time, and with a small expenditure of electric force. **This was really the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purposes of general use in houses and cities."**

....."**The principal and great thing described is the attenuated filament, and its inclosure in a perfect vacuum."**

....."**We think we are not mistaken in saying that but for this discovery electric lighting would never have become a fact. We have supposed it to be the discovery of Edison, because he has a patent for it. This may not be the case; it may be the discovery of some other person. But whoever discovered it, it is undoubtedly the great discovery in the art of practical lighting by electricity."**

....."**The bill must be dismissed."**

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Fig. 1. Shows oil dropping while machinery runs.

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Fig. 2. Shows flow of oil stopped when machinery stops.

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Vol. VI. CHICAGO, JANUARY 18, 1890. No. 3

East End Electric Light Company of Pittsburgh.

Since the East End Electric Light company of Pittsburgh, Pa., finished its arc light plant, that central station of electric lighting has become one of the most important in the country. Commencing with a very small number of lights generated by the direct current system about three years ago, the company has constantly increased its plant until the buildings now cover an acre of valuable ground, stocked with machinery which operates no less than 16,000 incandescent lights and 480 arc lamps. The company was organized January 20, 1886. At that time the plant consisted of a three hundred light Westinghouse direct current dynamo and a 45 horse-power Westinghouse automatic engine. In June, 1887, the directors of the company decided to adopt the Westinghouse alternating current system. A new building for the central station was erected on Broad street, East End, and this structure was equipped with Westinghouse alternating current apparatus of a capacity of 3,900 lights. Two 1,300 light dynamos were placed in the structure as well as two 650 light machines, with two one hundred and fifty horse-power and two seventy-five horse-power Westinghouse automatic engines. In addition, two Westinghouse No. 8 exciters driven by twenty-five horse-power Westinghouse automatic standard engines were used. Four one hundred horse-power Riter & Conley boilers represented the steam battery of the plant. The most improved electrical appliances were utilized in fitting up the plant, and when, in March, 1888, operations were commenced, it was generally conceded that the station was a model plant.

From the day of its operation, the business of the company increased very rapidly. The company made a specialty of furnishing electric lights in private houses and was particularly successful in that field. Applications became so large and so urgent that repeated increases in the plant were made. The company then deemed it advisable to go into the arc light business. A lot adjoining the incandescent plant was purchased, and in February, 1889, ground was broken for the building of the arc light plant. This plant was finished a few weeks ago. The arc light plant, which is shown in Fig. 1, is located in a lofty, well-lighted hall of large dimensions. The floor is covered with asphalt. As the view shows, there are two rows of electric light machines; six Waterhouse arc light dynamos of thirty-five lights capacity each are arranged on each side of the room. At the farther end of the room is the new sixty light machine of the Westinghouse arc light system. Each machine is placed upon a platform of brown colored wood.

Behind the machines runs an underground conduit into which all the wires from the dynamos are conducted. From this conduit, they run to the switch-board and then to the top of the building into a cupola, from which point they are distributed over the overhead mains and lines on the streets.

A small door from the dynamo department leads into the boiler room. There are two batteries of two Babcock & Wilcox boilers each. Each has a capacity of two hundred and forty horse-power. The boilers are so piped that each boiler or battery can be used either independently or together. The boilers are supplied by natural gas, which is maintained at a uniform pressure of twelve ounces. The engines are all of the Westinghouse type. The arc light plant has been built to admit of machinery for a capacity of 1,000 arc lights.

The incandescent plant shown in Fig. 2 is large enough to hold six three thousand light alternating current machines and two exciters. The apparatus is arranged in about the same way as the arc light machinery. Everything is located on one floor, so that the entire plant may be seen from any point in the building. The advantage of this is obvious when it is considered that on this account the company only requires one engineer during the day and one fireman, while at night only two engineers are necessary.

FIG. 1. EAST END ELECTRIC LIGHT COMPANY OF PITTSBURGH—ARC PLANT.

The company furnishes four hundred houses with 7,000 lights. All customers are furnished an alternating current meter. The company supplies fourteen churches with the electric current. The farthest incandescent lamp is situated five miles from the central station.

The switch-board in the incandescent plant also deserves attention on account of the ease with which it can be operated. Its entire arrangements are placed in a row on one wall.

The officers of the company are: A. T. Rowand, president; J. R. Van Wagener, vice president; G. P. Shane, secretary and treasurer; J. A. E. Hoeveler, superintendent of construction; A. H. Lucas, chief engineer.

The Studebaker Wagon company has installed a new 200 horse power dynamo in its works at South Bend, Ind.

Western Union Building at St Louis Destroyed by Fire.

The Western Union Telegraph building in St. Louis was destroyed by fire January 8th. The origin of the fire is attributed to a cross between the wires of the district messenger service which enter the building on the first floor and an electric light wire. Whether this was the cause or not, the fire started in the messenger office, and the several floors were soon enveloped in flames. The fire spread to the adjoining buildings, the upper stories of which were occupied by the Western Union Telegraph company. It is an old structure, and the flames spread with such rapidity that the operators in the upper stories had a narrow escape. Some of them rushed down the stairways and others made use of the fire escape. The Western Union sustained a heavy loss. The entire plant was totally destroyed. All the instruments, together with a large amount of battery and copper wire and considerable paper were utterly ruined by the fire and water. Mr. Bohle, the local manager, stated that it was impossible to tell what the exact damage would foot up. The company carried no insurance.

Before the fire was fairly under control, the Western Union company began to make preparations for temporary quarters where business might be handled. A building on Pine street was secured, and the work of stringing wires at once begun. For a long time all business was refused, and as a consequence the Postal company had its hands full taking care of the telegraph business. The work of putting in batteries and transferring wires and cables was pushed rapidly by the Western Union people, and by 3:50 P. M. they had one wire working to Chicago. It was a very unsatisfactory wire, however, and no messages were received for transmission over it unless they were filed with the distinct understanding that they were subject to delay. All the books and messages received during the night were saved, and the other books and papers were in the vault and were saved from damage by fire or water.

Two cables of twenty conductors each were strung into the new quarters, but it was found impossible to operate them, owing to lack of instruments. The wires leading to the cupola of the old building were all right, but had connections been made, the lack of instruments would have prevented the working of them. A force of men was sent to the Relay Depot, in East St. Louis, where the wires which centered at that point were cut, connections made and business dispatched across the bridge by messenger. On the following day a large number of instruments from Chicago was received, and the work was disposed of in regular order.

Eastern Delegates to the Kansas City Electric Light Convention.

In the last number of the WESTERN ELECTRICIAN it was stated that the secretary of the Chicago Electric club had been authorized by the Board of Managers to extend an invitation to the eastern delegates to the Kansas City Electric Light convention to lunch with the club Monday, February 10th. This invitation has since been extended to the eastern delegates and has been accepted on their behalf by Allan V. Garratt, secretary of the National Electric Light association and Geo. F. Porter, the general manager of the transportation committees. The acceptance of this invitation will necessitate a change in the time at which the special train from the east will leave Chicago for Kansas City. The train will now leave Chicago for Kansas City with the Chicago coaches attached about five o'clock on the evening of February 10th instead of in the morning, as originally planned. This will give the eastern delegates a full day in Chicago and enable them to partake of the Electric club's hospitality. It will also enable the eastern and western delegates to go on to Kansas City from Chicago on the same train.

Secretary Garratt has sent the following circular to eastern members of the National Electric Light association:

I am in receipt of an official communication from W. A. Kreidler, secretary, invitirg the eastern delegates *en route* to the Kansas City convention of this association to accept the hospitality of the Chicago Electric club on Monday, February 10th. I have accepted this very courteous invitation on your behalf. You will receive under separate cover a communication from Clarence E. Stump, chairman transportation committee, giving full particulars relative to the "Special Electric Limited" Pullman train, which will be run for the accommodation of delegates and their friends from New York to Kansas City, leaving New York Sunday morning, remaining in Chicago on Monday, and arriving in Kansas City Tuesday morning. You are earnestly requested to promptly respond to the above named communication, and thereby enable the New York transportation committee to carry out their somewhat difficult task, to the best advantage. Delegates from New England will communicate with Fred A Gilbert, of Boston, who is chairman of the New England transportation committee.

C. E. Stump of New York, has issued a circular relative to the special train for the Kansas City convention, from which the following extract is made:

For the benefit of delegates and others attending the eleventh convention of the National Electric Light association, to be held at Kansas City, February 11th-14th, arrangements have been made with the Pennsylvania railroad to provide a magnificent vestibule train to be known as the "Electric Limited" to be run through without change to Kansas City, via Chicago and the Chicago, Burlington & Quincy railroad. This train will leave Jersey City Sunday, February 9th, at 9:45 A. M., sharp, arriving at Chicago Monday morning at 9 A. M. Monday will be spent in Chicago, the Chicago Electric club having kindly invited the Eastern delegates to enjoy its hospitality during their stay in that city. The "Electric Limited" will leave Chicago Monday evening at 5 o'clock, arriving at Kansas City early Tuesday morning. Passengers should be careful to take the ferry at foot of Cortlandt or Desbrosses streets, New York, not later than 9:30 A. M. Sunday morning. No effort has been spared by the transportation committee in obtaining the very best equipment, and the committee is assured that this train will be the finest ever run out of New York.

Western delegates starting from Chicago can secure berths on the special train by addressing W. W. King, city passenger and ticket agent of the Chicago, Burlington & Quincy railroad, Clark and Adams streets, Chicago.

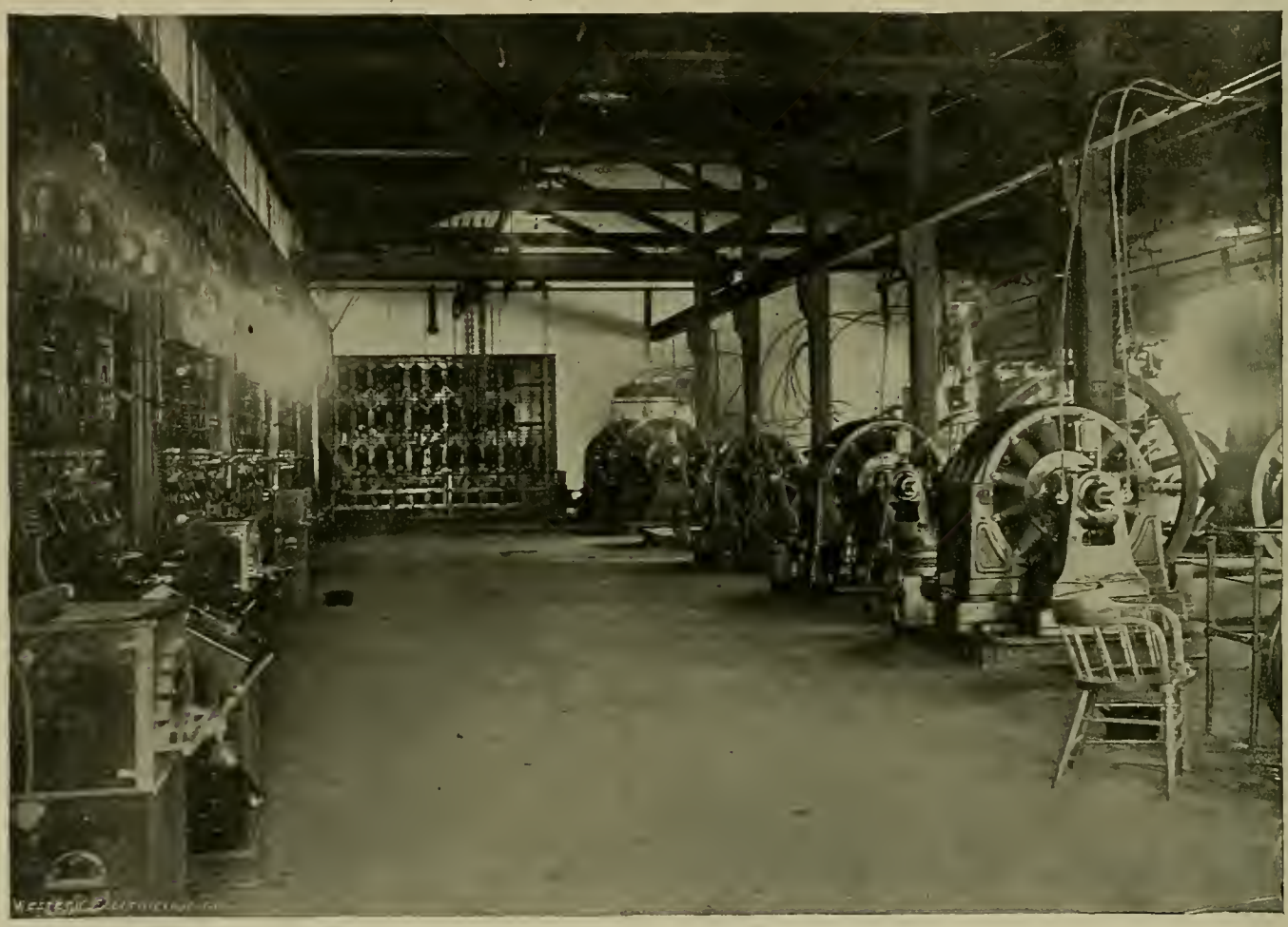


FIG. 2. EAST END ELECTRIC LIGHT COMPANY, PITTSBURGH—ALTERNATING SYSTEM

An effort is being made by the new street car company at Rochester, N. Y., to secure the electric railway between Rochester and Ontario Beach. The capital stock of this company is $200,000 and it has proved a most valuable investment to the owners.

Switch for Constant Potential Motors.

The accompanying cuts illustrate a simple switch designed to be used in connection with constant potential motors. In starting the ordinary constant potential motor by means of the usual form of resistance box, the field circuit is first made, and then the current is thrown gradually upon the armature. This action leaves the switch lever on the box in its final position, *i. e.*, with all the resistance cut out of the armature

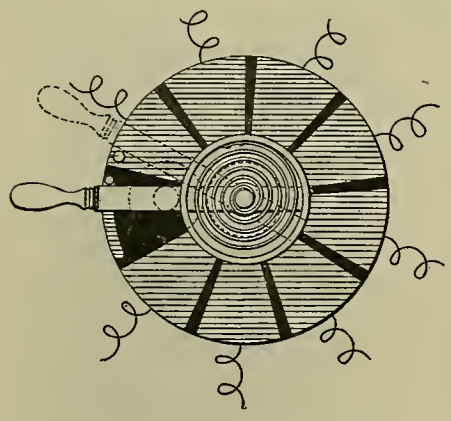


FIG. 1. SWITCH FOR CONSTANT POTENTIAL MOTORS.

circuit. In stopping, the operator first breaks the main circuit and then turns the switch lever back to its first position ready for another start. Very often, however, the operator forgets to turn the lever back, and when the time comes to start the motor, turns the main switch, and thus throws the full current into the armature before it has time to generate its counter electromotive force, and thus reduce the current flowing through it. The result of this is that either the armature is burned out or the fusible plugs put in for its protection are blown. The switch here described was designed to overcome this difficulty. The manner in which the device is rendered automatic, will be readily understood from a glance at the cuts. The contact blocks connecting with the resistance coils are arranged about the fulcrum of the switch lever as shown. Attached to the lever is a coiled spring which is so arranged that it tends to swing the lever around to its starting position and thus bring the resistance in circuit with the armature. In the body of the switch is set a horseshoe electromagnet. The switch lever is pivoted at one pole of this magnet and is in reality its armature. The magnet is connected in the field magnet circuit. The action of the device will now be readily understood: As the lever reaches the last segment, the armature of the electro-magnet rests upon the other pole of the magnet, and is thus held by it against the action of the spring, which tends to bring the lever back. The coils of the electro-magnet being in series with the field, the lever will remain in this position as long as the field circuit and main circuit are not broken. When the main circuit is broken, whether accidentally or, as usual, by the operation of the main switch, the motor will gradually slow down, and when it has nearly stopped the lever will fly back to its original position by the action of the spring. The switch is the invention of H. H. Blades of Detroit, Mich.

The Rhode Island and New Hampshire State Electric Lighting Associations.

The central station companies doing business in the state of Rhode Island, organized a state association January 7th. A majority of the companies and about 75 per cent. of the capitalization in the state was represented at the meeting. Letters were read from the officers of companies who could not attend, expressing their approval of the movement, and pledging their co-operation. The organization was effected by the election of the following officers:. President, Samuel P. Colt, Bristol Electric Light company; secretary, Samuel G. Stiness, Pawtucket Gas & Electric Light company; treasurer, Marsden J. Perry, Narragansett Electric Lighting company. The officers of the association constitute its executive committee.

The central station companies of New Hampshire held a meeting to organize a state association Thursday, January 9th. The response to the call for the meeting was almost unanimous. Nearly every company in the state was represented, either in person or by letter. A careful estimate showed that over 80 per cent. of the capital employed in central station lighting in the state was represented in person. The desirability of organizing a state association was discussed, and the proposal to organize at once was cordially indorsed. The organization was effected by the adoption of by-laws and the election of the following officers: President, Alonzo Elliott, Manchester; vice-president, F. W. Eastabrook, Nashua; secretary and treasurer, Edgar Woodman, Concord. Executive committee: Alonzo Elliott, Manchester; F. W. Eastabrook, Nashua; H. W. Burgett, Dover. A resolution was adopted directing the secretary to send an invitation, with a blank application for membership, to every central station company in the state. After the adjournment of the meeting President Elliott's invitation to partake of a dinner, was accepted.

Storage Battery in a Dental Office.

The accompanying cut of Dr. T. L. Gilmer's dental office in Chicago furnishes an interesting illustration of the adaptability of the storage battery to dental and other work of a similar character. About a year ago Dr. Gilmer decided to put in an electric motor to drive his dental engine. As no satisfactory arrangement with a local electric light company could be made, he decided to use the storage battery, and gave his order to the Pumpelly Storage Battery & Electric Motor company. This company furnished him with two of its 23M type cells which were inclosed in a neat wooden case, as shown in the cut. The two cells together deliver current at a pressure of from 4 to 5 volts. The motor used is a ⅛ horse power 8 volt reversible C. & C. machine. Power from the motor is transmitted to an Elliott suspension engine by means of a cord running over pulleys, as shown. The motor is controlled by means of two ordinary push buttons. These are placed on the floor just beneath the back of the chair, so as to be within easy reach of the operator's foot. One button throws the battery on without resistance, and therefore gives the highest speed at the motor. The other button, however, makes a connection between battery and motor through a length of comparatively fine copper wire. This latter arrangement gives a slower speed. When it is desired to change the direction of rotation of the engine, it is only necessary to move the small handle slightly at the motor brushes. The battery shown in the cut has been

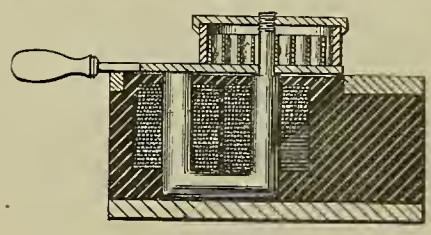


FIG. 2 SWITCH FOR CONSTANT POTENTIAL MOTORS.

running about twenty-three days. It may be mentioned that the performance of both the battery and motor has thus far proved most satisfactory.

Meeting of the New York Board of Electrical Control.

After nearly three months' inactivity during which time the property of the electrical companies of the city was ruthlessly destroyed by city employes, the New York Board of Electrical Control met last week to prepare its report to the governor and legislature. A truthful report of the proceedings of this body would prove a most interesting document, as it would show the dilly-dallying policy that has been followed and prove the inefficiency of the board to cope with the work in hand. But it was not the intention of this ornamental body to present a faithful report of its proceedings; it is merely a

STORAGE BATTERY IN A DENTAL OFFICE.

continuation of a policy heretofore followed. It does not speak of the injustice of its action in cutting the wires of electric companies before providing conduits for them and its refusal to permit them to build their own conduits when the Subway company acknowledged its inability to keep pace with the demand. Here is an extract from its report:

It is found that the condition of the overhead wires in the city is very bad. The rules and regulations of the Board of Electrical Control are violated everywhere. Unnecessary and "dead" poles and wires make up from 30 to 50% of all those existing. The poles made use of and the method of construction, as well as the way in which the wires are strung, are not in accordance with proper principles, nor in harmony with the character of the buildings along the streets, nor of a description enabling the freest possible use of the streets for other purposes. The wires are almost uniformly dangerous, especially those devoted to the electric light service. They obstruct the fire department; the poles are found duplicated by other lines alongside of them, where one line would be ample for the business of both. The wires cross streets and enter buildings irregularly, instead of at right angles, as they should; the poles are crooked, unpainted, different in size and shape; the cross-arms upon them are irregular, and the entire construction is unsightly and improper. As an instance of the utter recklessness and carelessness of the companies, they have in every possible case, except where they could gain or save something, thrown upon the city the burden and expense of removing the poles and wires which were unnecessary to them.

Mayor Grant opposed the adoption of this report. Its statements were conflicting, he said, and he refused to indorse it. The other commissioners, however, outvoted him. Henry S. Kearney, engineer of the board, presented his report, in which he said the condition of the subways was satisfactory in the main. This formed the subject of another spat between the mayor and the commissioners. When the mayor called Mr. Kearney's attention to the report presented by the engineer in October, 1887, in which reference was made to a map showing the progress of the work on Eighth and Third avenues, and which he had failed to produce, Commissioner Gibbens undertook Mr. Kearney's defence. The mayor persisted in his demand for an explanation of the manner in which the business had been conducted, and Commissioner Gibbens finally said: "The manner in which this board does its business, is to be decided by the board itself."

"I called attention to it," retorted the mayor, "because I regarded that as a very loose and careless way of doing business. I want the records so kept that a glance will be sufficient to tell when work was ordered, when it was begun, how far it extended, and when it was finished. It is impossible to do this in regard to the Third and Eighth avenue subways. I don't believe the work there was done under proper regulations, and I want to go on record as being opposed to that system."

This proved a disagreeable surprise for the commissioner, and he hastily withdrew a resolution he had offered in favor of adopting Engineer Kearney's recommendations. The engineer was instructed to confer with the commissioner of public works regarding the extension of the subways.

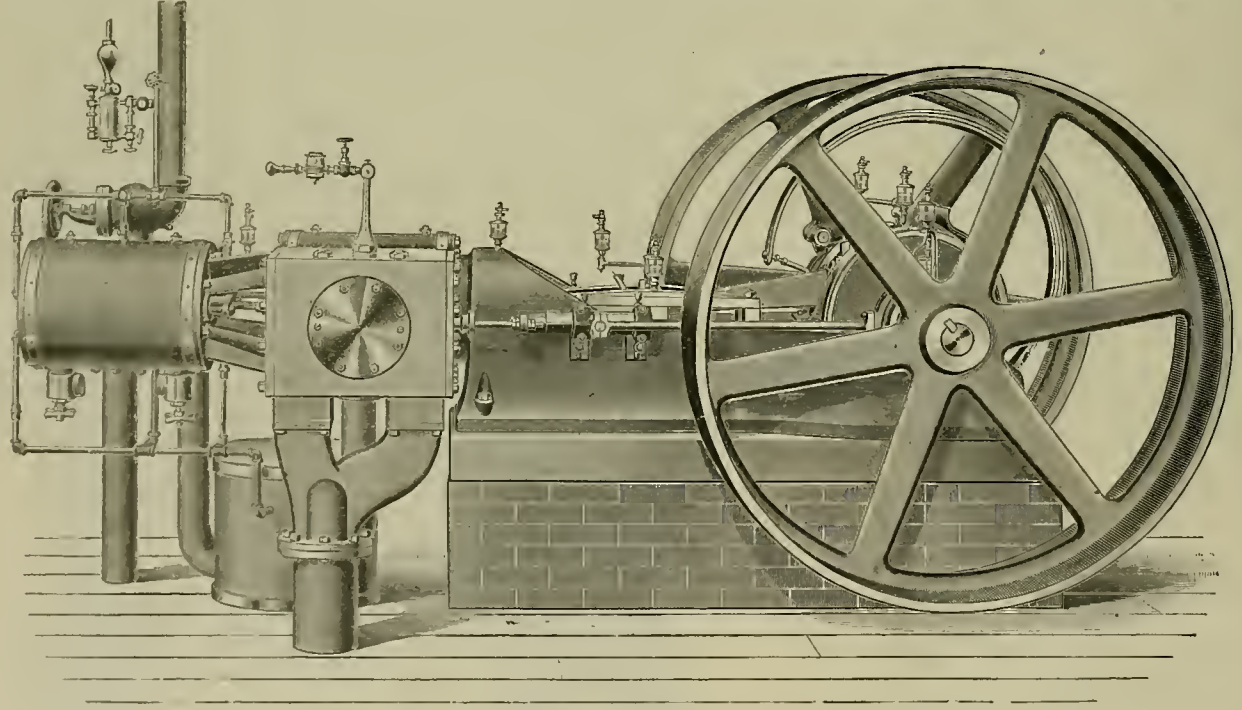
The report of the electrical expert which was read, is an exhaustive one. The total mileage of wire operated underground by the various companies is given as 12,308. It continues: "The results of the use of the underground conductors in the subways are very satisfactory. The tests of the conductors used for high tension currents show that there is no deterioration perceptible in the cables by reason of such use as they have been subjected to, in some instances, for six months. Whenever imperfections in the underground circuits have been ascertained as existing, by the tests furnished by the companies, they have proved due to bad workmanship in making joints and connections, or the exposure of the ends of cables to the weather." A modification of the subway rules is recommended in order to enable the Construction company to compel the compliance of the companies with the provisions for the furnishing of tests of underground conductors.

The report states that the condition of the overhead wires is still very unsatisfactory and that an immense amount of unnecessary and improper electrical construction still remains. The Department of Public Works has removed to date 3,007 poles and 2,827 miles of wire, as against 1,765 poles and 2,788 miles of wire removed by the companies.

A resolution was adopted requiring Expert Wheeler to report to the board the location of all dead wires and directing the Commissioner of Public Works to remove them.

Compound High-Speed Engine.

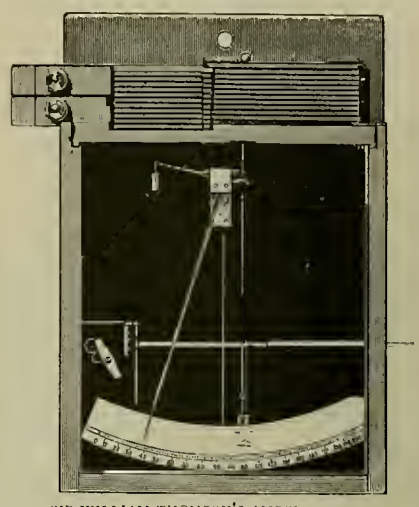
The accompanying cut illustrates the general design of a new compound high-speed engine, which is being introduced by McIntosh, Seymour & Co. of Auburn, N. Y. This engine is of the horizontal tandem type. Its chief peculiarity lies in the position of the valves and their gearing; the high pressure valve being on one side of the engine and the low pressure valve being on the other. This disposition of parts makes it an easy matter to reach the moving portions of the mechanism and avoids what might otherwise be a very complicated arrangement. The low pressure valve is moved by a fixed eccentric. The valves are of the piston type, and are all provided with adjustable seats. The governor is quite simple. Without any tendency to over-sensitiveness, it will regulate the speed of the engine, it is claimed, within one per cent. For electric railway service this engine is made much heavier than for ordinary work. It is provided with a larger shaft and greater length of bearings, and the fly-wheels are made nearly double the weight of those furnished for ordinary purposes. We are indebted to the *Street Railway Gazette* for the illustration.



COMPOUND HIGH SPEED ENGINE.

Sir William Thomson's Ampere Gauge.

Sir William Thomson's new ampere gauge is shown in the accompanying illustration. The following description is taken from the London



SIR WILLIAM THOMSON'S AMPERE GAUGE.

Electrician: The ampere gauge is of simple construction, having a vertical base-plate of paraffined marble, to which are attached a solenoid of special form; brass bearing plates supporting a balance which carries a soft iron plunger on its one arm and a brass counterpoise weight on the other; a brass arc having a scale graduated to give direct readings in amperes; a hinged arm which bears a light checker. The solenoid is built up of copper plates with mica insulation between them, and is fixed to the base plate so that its core is vertical. The balance is supported on knife edges at such a distance below the solenoid that the top end of the plunger is slightly entered into the core. The plunger is made from a thin soft iron wire about 20 centimeters long, and is supported by a cross-bar with two hooks on it which pass over two knife-edge stirrups on the arm of the balance. It has a brass weight hung on its lower end in order to keep it in a vertical position and prevent its being attracted against the side of the solenoid. An indicating needle, or pointer, formed from a strip of platinoid, passes down from the trunnion of the balance to the brass

arc bearing the graduated scale. As the plunger is attracted upward this pointer passes round the scale, and indicates the strength of current passing through the solenoid.

Several types of the ampere gauge are made covering a range from .5 to 500 amperes, and are available as measures of electric current on either direct or alternating circuits. They are standardized by direct comparison with Sir William Thomson's standard electric balances, and when the instrument is intended for alternating currents the graduation is made to suit the period of alternation in use on the circuit for which it is desired.

Double Carbon Arc Lamp.

The cuts presented herewith illustrate the mechanism of the double carbon arc lamp of the Western Electric company, Chicago. The lamp is the invention of C. E. Scribner, of the Western Electric company. The object of the designer was, to use his own words, "to improve the action of double carbon arc lamps so that a uniform length of arc may be maintained during the whole time the lamp is burning, and at the same time render the lamp more sensitive and certain in its operation."

This is accomplished by relieving the set of carbons that may be burning, whether one set or the other, from the weight or influence of the idle set. By thus relieving the special regulating mechanism of the set that is burning from the influence or weight of the mechanism of the other set, the arcs of the different sets are kept practically of the same average length, at the same time the lamp is caused to burn, whether one set or the other may be in service, until both sets of carbons are consumed.

A feature in the lamp is that the action of the feeding and regulating mechanism is precisely the same whether the arc is burning on one side or upon the other, and it is matter of indifference determined by the accidental resistance of the two sets of carbons which set takes the arc when current is first closed through the lamp.

Referring to the cuts, Fig. 1 is a side elevation partly in section. Fig. 2 is a diagram showing the circuits of the lifting magnet, MM', the carbons and the retaining magnets LL'. The same letters designate like parts in the three cuts.

The action of the lamp is as follows: When the current is switched on, the armature B, Fig. 1, is pulled down and rests on the magnet MM.

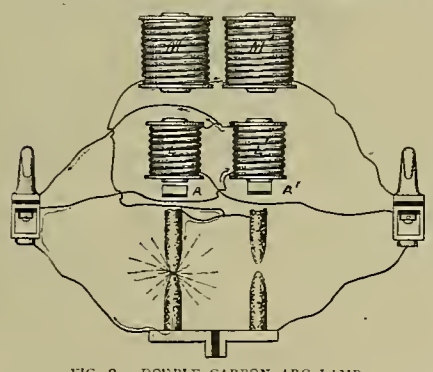


FIG. 2. DOUBLE CARBON ARC LAMP.

As B descends it lifts, by means of rod R and another lever, both shown in Figs. 1 and 3, the two independent levers N. These levers carry the clutches C and C. The retaining magnets *LL'* now come into play. These magnets are provided with circuits arranged, as shown in Fig. 2; so that when one arc is burning the retaining magnet of the idle pair of carbons will be in circuit with it. When the lamp is first brought into circuit, the central lifting lever or yoke is raised, and with it both clutch levers, so as to separate at the same time the members of the two sets of carbons. Now for reasons well understood, two arcs will not persist in different sides of the same parallel circuit. Therefore, only one persisting arc is formed, the location as between one set or the other being determined by the accidental resistance in the different sides of the parallel circuit. The members of the pair which do not take the arc are, however, separated, and the armature of the clutch-lever of the idle rod, say A', is brought within the active influence of the pole of its retaining magnet. This retaining magnet, as before stated, is now energized and is of sufficient force to attract its armature, thus lifting the clutch-lever of the idle rod from the yoke or central lifting lever. In this position the clutch-lever of the idle rod is held, until the carbons of the first set are practically consumed. The arc is shifted to the other set in the following manner: The rod of the pair first to burn is provided with a stop, which comes against the frame of the lamp, preventing any further feeding of the upper carbon. The arc increases in length until finally it goes out. The arc being thus extinguished, its circuit is interrupted and the retaining magnet of the other set is demagnetized, thus permitting the clutch-lever of the unburned set to fall. The fresh set of carbons

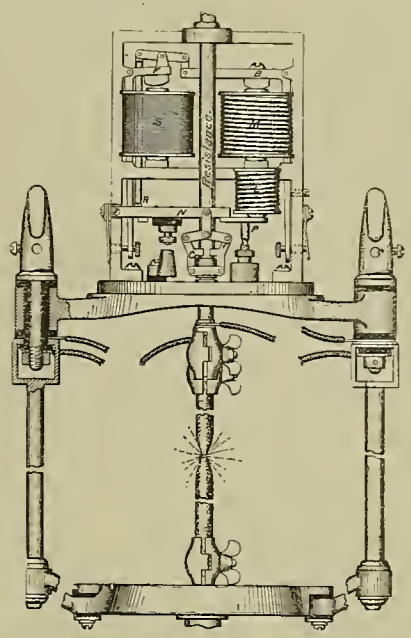


FIG. 1. DOUBLE CARBON ARC LAMP.

thus brought together, the circuit is again established through the lamp. The lifting magnet, MM', performs its function of separating the second set of carbons, and the new arc is established, while at the same time the retaining magnet A of the first set is brought into service. The armature of the clutch-lever of the first set, being brought within the active influence of the pole of its retaining magnet, is attracted and the weight of its clutch and rod is taken off from the central lifting lever. Thus the set of carbons last to burn is relieved from the influence of the rod, clutch, and clutch-lever of the burned set.

The automatic cut-out and feeding mechanism also serves to shift the arc from one set to the other when the first set of carbons is consumed. This shifting mechanism will be readily understood by reference to Fig. 1, in which are shown the contact points at N. These, when closed, form a circuit through the resistance shown at the center of the lamp.

In case the length of the arc is increased beyond the normal, more and more current is shunted through the feed-magnet S, Fig. 1, until its armature F is attracted sufficiently to cause the central lever attached to R to descend below the point at which a feed would take place if the rod were not held by its stop, and when this lever is thus caused to descend, the contacts will be together. These points being closed, the lamp is shunted through the resistance and the arc extinguished. The retaining magnet which was included in circuit with the arc thus put out will thereupon lose its magnetism. The armature of this retaining magnet is thereupon released, and the clutch-lever which had been held by this armature falls and rests upon the central lever, and the carbon-rod is released. The circuit is thus established through the second set of carbons. The retaining magnet L being included in the arc thus established, its armature A will be raised, thereby lifting the rod and upper carbon of this set. The central levers will be thus relieved from their weight. The lamp will then continue to burn until the carbons of the second set are consumed. Then the rod of the second set will be held by its stop until finally the lamp will be again cut out, this time permanently, by the automatic cut-out.

Border Land of Science.

The following is an extract from Prof. R. H. Thurston's article on "The Border-Land of Science" which appeared in the January *North American Review*:

"We are already familiar with the telegraph, transmitting messages across land and under sea, around the world; we have even discovered a method of sending over its wires the *fac simile* of a written, or a printed, or an engraved page; the hand which writes a letter at one end of the line is imitated at the other by the pen of the lightning, and his every line, curve, and dot and dash exactly reproduced under the eye of his waiting correspondent. Who knows but that the time may come when his portrait may go with his letter, or even the words of his mouth, sent through line of telephone, be apparently the issue of the familiar face speaking, like a voice from the Arabian Nights, across the world? The Morses, the Bells, and the Edisons of coming years may be relied on to perform no less wonders than those which now astonish us; and the phonographs and graphophones of later days and of future ages will record in their own voices and their own language, for all the eternities of earth-existence, their thoughts and their triumphs, in dormant, but ever-living form. The great electricians of to-day are teaching us how to convert the energy of the steam engine into the newer form and to apply it to the illumination of our streets and our dwellings, and to employ it in the operation of all the machinery of shop and mill and home. The time may yet come when, by the employment of this wonderful conveyer of power, the energy of all the coal mines, or of the immeasurable tons and tons of water pouring over that tremendous precipice of Niagara into the abysses of the whirlpool and the rushing rapids below—over three millions of horse-power—may be transmitted along a copper wire to distant cities to furnish the motive power of factories, of workshops, and of innumerable home industries, doing its share of the great work yet to be performed, of breaking up the present factory system and enabling the home-worker once more to compete on living terms with great aggregations of capital in unscrupulous hands.

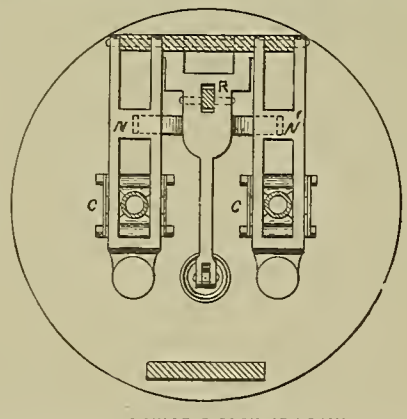


FIG. 3. DOUBLE CARBON ARC LAMP.

Great steam engines will undoubtedly become generally the sources of power in our larger cities, and will send out over the electric wire, into every corner of the town, their Briarean arms, helping the sewing woman at her machine, the weaver at his pattern loom, the mechanic at his engine lathe, giving every house the mechanical aids needed in the kitchen, the laundry, the elevator, and, at the same time, giving light, and possibly even heat, in liberal quantity and intensity. It may become a more powerful genius than was ever dreamed of by Scheherazade, and described in the 'Arabian Nights' Entertainments.'"

The Citizens' Electric Street Railway company, Champaign, Ill., has been incorporated to operate a street railway; capital stock $150,000.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - -
F. L. PERRY, - - - - - - - - - - Business Manager.
A. C. DURBOROW, JR., - - - - - -

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE great importance of the United States electrical exhibits at the Paris Exposition is shown in an article by Carl Hering, presented on another page.

IN AN article in this issue, Allen R. Foote speaks at considerable length of the importance of the electrical department of the eleventh census, of which he has charge.

ST. LOUIS has had a hard time with its wires during the last ten days. First came a storm which demoralized the circuits of all the companies. Then the destruction by fire of the Western Union plant rendered useless the great majority of the telegraph wires. To complete the misery of the companies the blizzard of last Sunday played havoc with all the wires in the city.

AN article in another column dealing with the copper question merits a careful perusal. As it is stated in the article, "If the duty on copper was of more than doubtful expediency" a few years ago, when the commercial uses of the metal were somewhat limited, it becomes almost a crime in view of the demand for it that has been created by the industrial applications of electricity."

IN a recent issue of the WESTERN ELECTRICIAN appeared a statement to the effect that Prof. Pacinotti had died at his home in Pisa. We are glad to state that the report announcing his death was erroneous. The mention was made on the authority of an English journal. The mistake probably arose from the fact that the great electrician's father died a few weeks ago.

THE electric railway system has scored another great victory. Rapid transit in Minneapolis will be accomplished by the employment of electric motors. The introduction of a large number of cable lines was contemplated, but the success of electric railways has been so marked that all the plans have been abandoned. The steam motor which puffed and shrieked through several important thoroughfares will soon be a thing of the past. A decision has just been reached in accordance with which all the lines in Minneapolis will be equipped with electric motors. This determination was not made without a careful investigation. An experiment was made on one of the lines, and the new system satisfied the people so fully and operated so successfully in spite of snow and cold, that the owners of the road were no longer in doubt. In St. Paul a large part of the street railway system will be operated by electric motors. That the railway managers found the electric system wonderfully superior to the cable method is shown by the fact that they discarded the latter even though they had purchased considerable material for cable construction, and much of it was already on the ground, and will prove almost a total loss. It is the boast of the residents of the Flour city that in a short time they will be able to ride over 100 miles of electric railway.

IT seems a strange fact that during all the excitement over wires which has from time to time attained considerable intensity in New York city during the last three months, the Board of Electrical Control has not found it necessary to hold a meeting. Yet such seems to be the fact. The meeting which is reported in this issue is the first session which has been held since October 15th last. The commissioners had their usual misunderstanding with Mayor Grant, and the latter refused to sign the annual report to the legislature. This report states that "the responsibility for the condition of the wires in the city of New York is a dual one"; that the providing of subways and making of regulations is the duty of the Board of Electrical Control, while the enforcement of such regulations is the duty of the mayor and commissioner of public works. The failure of this "division of responsibility" to prove "as successful and effective as was expected" is urged as an excuse for the delay in the burial of the wires. There have been constructed in New York 73 miles of trench and 1,007 miles of duct, sufficient for 45,000 miles of telegraph and telephone wires and 2,000 of electric light wires. The condition of overhead wires in the city is reported to be very bad, from 30 to 50 per cent. of them being unnecessary or "dead." It is suggested by the commissioners that full power should be vested in one official or board to carry out the intent of the laws relating to electric wires.

BOSTON is now considering the question of appointing a commission which will have full control of all electric wires in the city. With the experience of New York fresh in mind the press of the city protests against the appointment of "a Board of Electrical Control like that of New York." With the present demands for electrical engineers the papers see no probability of securing a board composed of experts, but one of the papers, however, recommends the appointment of "A commission of men not strictly electricians, but men of honesty and practical intelligence with a good general idea of the science of electricity." It is a satisfaction to see that the Boston press views this whole question in a much more intelligent way than does the metropolitan press. The following from the Boston *Transcript* is to the point: "That there is an element of danger in electricity is not to be denied, but that there is a far less degree of peril in this peculiar form of energy than in any of our other great forces is a simple truth that can be proved by facts and figures to any person of common sense. What dangers do exist can be so easily minimized by attention to details that if instead of crying 'Down with electricity' those whose duty it is should set about making and enforcing laws compelling companies dealing in the fluid to surround it with all the safe guards that have been amply provided, just as is done with steam boilers and such things, the use of electricity would become as safe as the use of water power in a very short time."

CHICAGO will have overhead wires after all. Commissioner Purdy has granted the Lake View Electric Light company a permit to erect wires on poles in Lake View. The council of Lake View, previous to that city's annexation to Chicago, had granted an ordinance to the electric light company allowing it to carry wires on poles for five years. Two years longer was also fixed as the time during which they were to be put underground. The matter has been held in abeyance for several days, as it was hoped that the ordinance granted by the Lake View council was invalid. The law department, however, informed the commissioner that the ordinance was legal, and he had no alternative but to grant the permit.

IT is with a profound feeling of satisfaction and pleasure that we felicitate the *Electrical World* upon its recent issue, containing in twenty-four copiously illustrated columns such a generous and appreciative description of itself and its surroundings on a portion of the ninth floor of the *New York Times* building. We are almost unprepared for the modest denial that the management of such an institution demands "more qualities than any business on earth." Bacon says, somewhere: "To praise a man's self cannot be decent, except it be in rare cases; but to praise a man's office, he may do it with good grace and with a kind of magnanimity." This admonition has been heeded in the article in question, and while the "office" is lavishly praised, we are left to judge of individuals by studying their portraits which are presented for our instruction in a series of views. The faces are distorted in several instances, to be sure, but then modest men rarely do secure good pictures of themselves.

When it comes to the "office," neither writer nor engraver spares the magic touch, and everything is revealed.

> No single parts unequally surprise,
> All come united to admiring eyes.

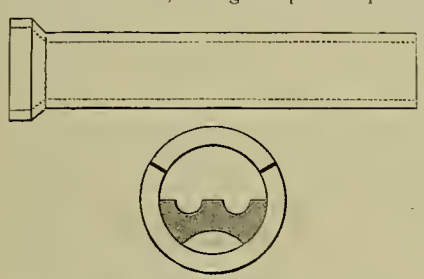
At the very outset an invitation is extended to the reader to journey leisurely through the labyrinthine departments of the establishment, with the author of the article acting as a guide. This invitation we accepted, and "as imagination bodies forth the forms of things unknown, the poet's pen turns them to shapes, and gives to airy nothing a local habitation and a name." We saunter from the general bureau of information to the press room, where, we are told, the paper is served "hot." We are shown a consultation in the president's room, but whether the discussion hinges upon the failure of the paper to secure the Edison lamp patent decision or upon some other "scoop," we have no means of ascertaining. There is revealed to us an industrious employe engaged in the intricate and delicate operation of "mapping out an ad.," and there is exhibited the process of wrapping up books in all its branches. We pass through the editorial sancta, "O, what a fund of genius is pent up in narrow spaces," catch a glimpse of an inventor who, as our guide tells us, is "pale, big browed and glances nervously round," ascertain that the company publishes nine books, of which one is out of print, discover that the owners of the *Times* building will let us inspect their dynamo and engine if we apply to them, are told if we go to the right places we can see the firms which set up the type and print the paper, and then our journey is ended. We have tried to emphasize the fact that the chief characteristic of the article is modesty. True it is that "modesty is the only sure bait when you angle for praise."

Underground Work at Nostell Priory.

The following description of an English installation from the London *Electrical Review*, would seem to indicate that our cousins on the other side of the water may be able to furnish a few hints in underground electrical construction:

An electric light installation of an important character, and possessing some features of exceptional interest, says our contemporary, was carried out rather more than two years ago at Nostell Priory, near Wakefield, the well-known seat of Lord St. Oswald.

When it was arranged that the Priory—a very large mansion, built during the last century—should be electrically lighted in preference to having gas brought in, it was decided that the power for doing so should be fixed at the collieries owned by Lord St. Oswald at Nostell, close to the Great Northern Railway, distant nearly half a mile from the house. The sale of the plant and cables at the Exhibition at South Kensington was an opportunity which was utilized, and the large engine built by Goodfellow & Matthews of Hyde, and a quantity of heavy cables were purchased for the purposes of the installation. The cables, all of 19-strand heavy wires, amounting to a considerable number of various lengths, were found after examination to be of different makes and insulation; some of vulcanized rubber, some of pure rubber, and some of gutta-percha insulation. It was found that, by the addition of some new cable, one main could be formed of wire insulated with pure rubber, while the other could be formed of vulcanized rubber, the gutta-percha portions



UNDERGROUND WORK AT NOSTELL PRIORY.

being left for house mains. After a considerable amount of trouble the several cables were jointed up into four special lengths, and forwarded to Nostell.

The route from the Priory to the colliery was through the park, by which the house is surrounded, to the main road, a distance of about 250 yards, thence through a plantation and some fields, to the colliery, a distance of about 500 yards. The cables were so arranged that the only joints necessary should be made on the colliery side of the main road, where a special manhole had been built, as the cables came in at different levels. Under the main road iron pipes, well jointed, had been laid, through which the cables were drawn; for the rest of the distance earthenware pipes of novel construction were used. These pipes facilitated the work of laying in the cables, and as time has shown, have answered very successfully the favorable expectations formed of them.

The accompanying illustration will explain their special construction. These pipes are 6 inch earthenware sanitary pipes, with about one-third of the circumference *nearly* cut through before baking. When brought out for use, this portion of the pipe will, on being tapped with a hammer, come loose, and can be lifted off. The pipes being laid in the trough prepared for them, and properly jointed, it will be seen that throughout their length they will have the upper third of their circumference open, enabling cables to be easily deposited inside, without either damage to the pipes or the cables. In addition to this special arrangement, there was also provided in the pipes, at short intervals, an earthenware bridge of the form shown in the enlarged section, containing two grooves for the cables to rest in and be kept separate, and having the under portion cut away, so that any water which might get into the pipes would have a free passage to the nearest drain place. The trench in which these pipes were laid was cut sufficiently deep to allow of a bed of rough clinker and brick, and up to the level of the top of the pipe, to allow of drainage. From the house to the roadway there was a fall, but at the roadway the cables to the colliery were in consequence partly of the depth of the pipes under the road, and of the height of the bank on that side considerably higher than the others. It was necessary here to get down to the level of the pipes under the road, and a manhole of considerable dimensions, well drained and bricked all round to a depth of eight feet, was constructed; at the lower level the cables from under the road came in, and at the upper level the cables from the colliery; this manhole was well protected with a stone cover, and then a large amount of earth put over. In here the several cables were permanently jointed, and after the lapse of more than two years we can safely assert that the cables in this manhole are in excellent condition, and the place itself all that could be desired. When the operation of laying the cables had been completed, the lid or loose portion of the circumference, of the pipe, was put in its place after some clay had been put on the pipe edges. When pressed home, the joint was complete.. The trenches were filled in, and have remained undisturbed ever since, except at one point for examination lately, when everything was found satisfactory, the lids being watertight.

As regards these earthenware pipes, it may be mentioned that as it was only intended originally to place two cables in them, only two grooves were made in the bridges. This system of piping for underground cables was devised early in 1887. For the service of the mansion there is a Crompton dynamo with an output of 220 amperes at 125 volts. This is driven by a Goodfellow & Matthew engine.

Proposed Wiring Regulations in Boston.

The sub committee of citizens of Boston, Mass., which has been investigating the question of insulation of electric light wires since the recent fire, has made a report in which it recommends that the legislature enact laws regulating electric lighting, and that the following provisions be incorporated:

For arc light and power wires, or others designed to carry current of over 250 volts:

That they shall not be placed so as to be concealed from view.

That they shall not be allowed in contact with wood or other inflammable building material that may become carbonized, but that they shall be separated from such material by at least ½-inch air space by use of non combustible, non-carbonizable insulators, placed near enough to prevent contact of the wires by sagging or otherwise, but not further than six feet apart.

That with such construction wires of opposite polarity shall not approach each other nearer than ten inches, except at the lamp and switch.

If the wires are incased in insulating tubing that is impervious to moisture, will not support combustion, and of sufficient mechanical strength to protect them from injury, the tubes may be laid as near as three inches to each other, and may be fastened to any building material by use of staples or such other means as will not injure the tubing.

All such wires must enter and leave the building at the same place in order that a non-combustible hand switch may be placed outside for the use of shutting off the current.

All insulating covering that will support combustion will not be allowed.

For incandescent light and power wires or others designed to carry currents of less than 250 volts:

If such wires are concealed within partitions or like places they must not be allowed in contact with wood or other inflammable building material that may become carbonized, nor with any conducting material such as piping or other wires.

They must be rigidly separated from such material by at least ½-inch air space by the use of non-combustible, non carbonizable insulators placed at intervals near enough to prevent contact by sagging of the wires or otherwise.

The wires must be kept at least six inches apart, except where they enter junction boxes, cut-outs or the like.

Wires laid in plaster, cement or other similar building material will not be allowed, no matter what insulating covering may be used.

In lieu of construction by air space and non-combustible insulators, wires may be incased in insulating tubing that is impervious to moisture, will not support combustion, and of sufficient mechanical strength to protect them from injury, and such tubes may be laid side by side in plaster, cement or similar finish, or in any concealed space where they will not be subjected to injury, and may be supported by staples, or such other means as shall not injure the tubing.

No switch or safety cut-out except those made of non-combustible material will be allowed.

For telegraph, telephone, messenger service and all other electric wires not heretofore mentioned, except public fire alarm and police wires and "series" electric light wires:

All such wires in any town or city in this Commonwealth where electric lights or power wires are being operated, must be provided at the entrance of any building, both ingoing and outgoing wires with some safety device that shall instantly open the circuit or shunt the current out of the building in case the flow of current shall at any time exceed in quantity or electromotive force that which is normally used on such wires.

Such safety device must be located as near as possible to the place where the wires enter the building, and in some place easy of access.

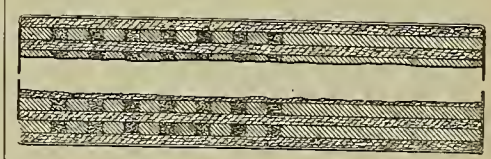
When the safety device is placed inside of the building, the wire connecting it with the outside wire must be of equal or greater carrying capacity.

The device must be mounted on non-combustible material.

All switches, cut-outs, insulators, insulation or tubing for use in electric lighting or power work, and all safety devices herein referred to must be approved by the committee or inspector in power before being used.

Forming Secondary Battery Plates.

In the process of constructing the plates of storage batteries it is the usual practice to apply the active material in the form of paste. In the following method, which is the invention of H. E. Dey of New York, the inventor utilizes the lead oxides in the form of dry powder. In carrying out the process the plates or grids are first packed with the active material in the form of a dry powder. The material is pressed into the spaces in the plate with sufficient force to prevent it from falling out or becoming detached from the plates during the manipulation necessary to their subsequent treatment. After a number of plates have been prepared in this manner they are made into a pile, and a piece of some fibrous material—such as a sheet of felt saturated with acidulated water—is placed between each pair of plates. This felt serves to



FORMING SECONDARY BATTERY PLATES.

hold the powder in place in the lead plates while being formed. A current is then passed through the pile of plates until the same are formed—that is to say, until the active material on one side of each plate has been converted into spongy lead and that on the other into peroxide of lead. The dry powder, by the action of the current, is so altered in its mechanical condition as to lose its tendency to dissolve or become detached from the plates. When the plates have been thus treated, they may be placed in the regular battery jars or cells, and used in the ordinary way. It is preferred in certain cases to prepare the plates in the manner above described by passing a current through them in series while forming them, whereby one side of each plate will be positive and the other side negative. If, however, it is desired to make each plate either positive or negative, connections are made from opposite poles of the charging or forming generator to alternate plates in the pile.

Mayor Grant and the Overhead Wires in New York.

In the annual message of Mayor Grant of New York, the following reference to the overhead wires in the metropolis appears:

"For many years our thoroughfares have been obstructed and disfigured by unsightly poles and dangerous electrical wires. Laws have been enacted providing for the burial of electrical conductors, but until recently, no apparent effort had been made to enforce them. In the early part of the present year energetic and decisive measures were taken to abate this nuisance. From some of the leading thoroughfares these obstructions have been entirely removed, and it is the firm purpose of the local authorities to prosecute this reform to a speedy completion. By the close of next summer it is confidently believed that every pole will be removed from the streets, and that every electrical wire will be operated underground in properly constructed subways.

"Since the first of January, 1889, the Bureau of Encumbrances has removed 2,905 poles, and about 14,500,000 lineal feet of electrical wires.

"The public authorities have recently felt com-

pelled to remove from the streets wires which were believed to be dangerous to human life. By this action some portions of the city were deprived of the use of electric lights. The interruption of this service will, however, be but a temporary one. Already subways have been constructed in some of the leading thoroughfares, and it is hoped that sufficient will be constructed during the coming year to accommodate the electrical industry in the city.

"By the provisions of law now in force the official existence of the Board of Electrical Control will terminate during this year, and its powers and duties will become vested in the Commissioners of the Sinking Fund. The duties of any board charged with supervision of electrical conductors must necessarily be onerous and difficult. They should be discharged by officers who possess some knowledge of electrical science. A Board of Electrical Control, composed, at least to some extent, of electrical experts, would be a great assistance to the local authorities in dealing with those branches of industry which are compelled to maintain electrical wires in the streets."

Investigation of the Electrical Industry for the Eleventh Census.

By Allen R. Foote.

The investigation of the electrical industry, to be reported in the Eleventh Census, offers an opportunity of great value to ascertain the true importance that the practical application of electric energy has acquired in industrial and social development. This opportunity should be made use of to the fullest extent possible. In all departments of endeavor an exact knowledge of existing and antecedent conditions is the necessary base from which to direct future action. Laws and actions based on assumptions, instead of ascertained facts, are the pitfalls of civilization. A business policy guided by ascertained facts, cannot fail.

Some managers of electric lighting and power stations have intimated to me that there are certain features of their business concerning which they do not desire to answer inquiries. They have acknowledged at the same time however, that information regarding those very points, if given by other companies, would be more valuable to them than any other data that can be obtained. So strong is the repugnance of some persons to the invasion of what they consider their private affairs, that sworn agents of the census frequently find it difficult to obtain information to which they are legally entitled. I believe the policy of secretion on the part of any individual, to be a mistaken one, adopted either under a misapprehension of the facts, or an ignorant view of his own interests. It may be stated as a fact that no person will be benefited more by the publication of an absolutely truthful statement, showing the operation of every company in the United States engaged in his line of business, than that person who doggedly refuses to answer inquiries, or retards the publication of the information to be collected by dilatory compliance with the requests sent him. A just punishment for his illogical selfishness would be to make his self-imposed isolation still more impenetrable, by debarring him from receiving any benefit whatever from the information given and work done by others. Such a person should be compelled to live where there are no mails, newspapers, railroads, telegraphs or telephones.

Information given to an agent of the census cannot be used to the injury of the giver. The interest of the government can be served only by protecting the interest of the individual. Every agent is sworn to secrecy and is under as strict supervision as are the national bank examiners. Every publication of the information obtained is absolutely impersonal, so that it cannot possibly be traced to any individual or company unless it should happen that but one person or company is employed in the occupation described. While these regulations offer protection to the individual, they at the same time offer him, in full and equal exchange for the information he can give, all the information obtained from every person in his line of business. The exchange is as a thousand for one. A consideration worth an hundred times more to any person or company than the cost of the effort they are required to make to obtain it.

In no department can the benefits that a citizen may derive from a well organized and intelligently directed governmental action be better exemplified than by the operations of the census office. The main features of the industrial information wanted, are plain statements of facts, which any well regulated business concern can furnish easily and promptly, from the accounts kept by themselves for their own advisement. To provide for the lack of uniformity in accounts and to inform all persons interested as to what inquiries they will be expected to answer, schedules are furnished months in advance of the date on which the information is wanted. This enables each concern so to keep account of the items, that on the day from which the information must bear date, an accountant can easily fill up the entire schedule and mail it to the census office. The advantages to be gained by individuals and companies in doing this, are a most generous return for so simple and easy an undertaking on their part.

The magnificent exhibition of co-operation with the government, that would be shown by simultaneously mailing a properly filled schedule to the census office on the same day by every company or person interested in the electrical industry, would mark the advance line of progress in census taking. Those who are placing this great agent of power, electricity, at the service of every citizen and municipality, by doing so will but sustain their well merited title of "Lightning Engineers." Really it is but a simple thing to do. It only requires that each one shall demonstrate himself to be the peer of the sun in his ability to do things on time. All things done require time for their doing.

It requires no more effort to do a thing at a proper time than to do it at any other time. Who so orders the doing of them that each is done when required, liberates himself from the law of necessity and makes himself master of circumstances. All that is required in this case, is that each company shall designate an officer or employe as the person who will furnish the information desired by the census office and hold him responsible for having it ready on the mailing date.

The lack of information that may be obtained through the census report has been felt so keenly that no less than ten individual attempts by as many central station companies to gain some part of it, have come under my observation during the year 1889. These attempts have been expensive to their originators and troublesome to those to whom they have made their appeals. Worse than this, they have been unsatisfactory, because too limited in the scope of their inquiries; and dangerous, because they have not covered all the factors necessary to a correct statement. Public or private action based on insufficient data, can but be ill-advised and disappointing. Such disadvantages may now be overcome with the greatest ease, to the injury of none and the advantage of all, if each person in interest will promptly and fully supply his own quota of census data.

It is not the business of the census office to report, or to prove the correctness of theories. It is its business to report facts. No person should be so eager to know facts, as the man with a theory. If the facts are with him, he will be enormously benefited by their helpfulness. If they are against him, a knowledge of them may save him disastrous loss. No man ever attained a success by remaining ignorant of the facts pertaining to his occupation. The electrical industry is so young it is almost too soon to attempt to separate the experimental from the practical. No feature of the wonderful progress made, which may now be recorded, is removed from its experimental stage by so much as a single decade. In view of this, it will be well to take notice of every experiment that is now being practically tested. Such a record will possess great interest for those who may be privileged to compare the results of the eleventh with those of the twelfth census. The experiments of to-day will furnish the best landmark for the progress to be recorded in 1900.

The report of the investigation with which I am intrusted will be the first official chapter in the history of the practical application of electricity to the uses of light and power. I do not assume the ability to write a report that shall be perfectly satisfactory to the 65,000,000 critics in the United States, not to mention those in foreign countries, to whom my work must be submitted. What I shall do, is to give every person who may criticize me adversely after my report has been published, a good opportunity to place himself on record, by making suggestions to me while the work is in condition to be benefited by them. No more time will be required to write a suggestion before, than to write a criticism after the work is finished, but much greater genius. The wisdom of foresight is a far more rare and valuable gift than the wisdom of hindsight. To look ahead to an objective point, and form plans which, if followed, will make one sure of getting there, is a work of immeasurably greater value than to look backward and tell how present conditions came to be so. The historian of events, real or imaginary, can never be a leader. Who declines to suggest, deprives himself of the right to criticise. Through the courtesy of the electrical press I urge every one interested in the electrical industry, each from his own point of view, to suggest to me every item of information that, in his opinion, should find a place in my report, together with his idea as to how it may be most easily and correctly obtained.

In my opinion, the facts to be reported form two distinct classes:

First, Facts of present value, the full benefit from which will be realized at the time of publication.

Second, Facts having a future value, the full benefit from which will be realized ten years hence, when comparisons are made between the results shown by the eleventh and twelfth censuses.

There are a multitude of facts of very great value to those directly interested in the industry, that have no value to the general public, except in a direct manner. The collection of such facts will be limited by the voluntary co-operation of those to be benefited in supplying them. I shall be greatly disappointed if there is any failure in this regard, especially since Hon. Robert P. Porter, superintendent of the census, has invited such co-operation in the following cordial terms:

"It is the purpose of this office, without seeking data which may be irrelevant or unimportant, to make the statistics of this industry complete and accurate, so that its real condition and true importance may be known and understood by the general public. It is confidently believed that those who are to derive the chief benefit from the result of the inquiry viz.: manufacturers and central station companies engaged in the distribution of electric currents for the commercial uses of light and power, will lend their cordial aid to render that result full and reliable. A formal response to the questions of the schedule is all that can be insisted upon, but the superintendent solicits beyond this the hearty co-operation of all persons interested in respect to furnishing information promptly and accurately, in the procurement of additional facts, and in the suggestion of pertinent and useful lines of investigation. Without such co-operation intelligently supplied, the inquiry must of necessity be limited in its value. * * *

"The census of 1880 makes no mention of the industry of generating and distributing from central stations, electric currents for the uses of light and power. The investigation of this industry for the eleventh census, will be the first official census report made on the subject, in this or any other country. For this reason it is particularly desirable and essential that the investigation shall not only present a record of the industry as it exists to-day, but that it shall so classify and arrange the information as to render it serviceable as a basis for present action and of comparison for all future reports. In view of these facts, the importance and value of such an investigation and the official publication of its results, should in itself be sufficient to secure from every person addressed, a special effort to answer fully and promptly every inquiry. The exaltation of the birth of an industry and its growth, to the magnitude of an interest second to none in importance within the short space of a single decade, is a marvelous record of progress. In no other industry and in no other country, has such a record ever been made."

The Duty on Copper.

A petition which is now in circulation, asking of Congress the abolition of the present duty on copper, ought to receive the signature of every man to whom it is presented, says the *Pioneer Press*. Without considering at the outset the strong special reasons for placing this metal on the free list, it is a notorious fact that the duty on copper has been productive of nothing but abuses for many years past. This is one of the instances where there never was a reasonable excuse for applying the principle of protective duties. The copper mines of Lake Superior, the richest in the world, are together with those of Montana, our principal source of supply. The deposits of copper are so distributed that the mines can be worked at little cost, and their situation on the border of the great Northern water route se-

cures cheap and easy transportation to the markets of the world. The United States could from the very outset have distanced competition anywhere in the world in the production of copper, without the assistance of any duty whatever. It always happens that a duty in such a case as this is productive of abuse; and the proper mining business has furnished no exception to the rule. In the first instance, this duty was made use of to raise and keep the price of this metal abnormally high. So extravagant were the prices asked under this protection that it is a well-established fact that American copper has been exported to Europe and then brought back to this country, where, after paying duty, it was sold in the market in competition with copper brought directly from the mines. It is no part of the protective system to foster such robbery of the consumer as this.

The natural result, of course, was to throw the business into the hands of a monopoly, and the trust idea was early adopted by those interested in copper production. The greatest speculation of recent times was thus encouraged, in the formation of the international syndicate or trust that used the copper market as its instrument to make immense fortunes out of a market artificially inflated and depressed. As a matter of fact, it is not certain that the duty on copper to-day is of benefit to any American citizen. The operations of the trust are carefully concealed; but it is understood that contracts have been entered into for the purchase, at a stated price, of the entire product of our principal mines for some years ahead. This arrangement was made by the trust for the purpose of making its control of prices absolute. It ill becomes this government to become a party to any such agreement, by maintaining a duty that closes the American market to any relief that the world might be able to offer. If the duty on copper was of more than doubtful expediency a few years ago, when the commercial uses of the metal were somewhat limited, it becomes almost a crime in view of the demand for it that it has been created by the industrial applications of electricity. Owing to its excellence as a conductor, this metal is now in great demand. Indeed, it is hardly too much to say that a cheapening of copper would go far toward solving the problem of conveying electrical energy without danger to human life. A current of sufficient power for lighting or other commercial purposes can be carried with ease over a large copper wire, but owiog to the greater cost of material many companies continue the use of iron wires, with a deadly current of high intensity. To the future development of electrical devices and appliances, the cheapening of copper, or at least a stable market value, is of the highest importance. It is not easy to find a single excuse for the existence of the duty on copper in the first place. If there was such, it is unworthy of consideration in opposition to the commercial needs of the day. Nor could the absence of all duty work half as much injury to the industry as has been done by the violent price fluctuations of the past, attributable to monopoly control. If Congress has the slightest conception of the meaning and need of tariff reform, it will place copper on the free list.

The Electrical Exhibits from the United States at the Paris Exposition.

By Carl Hering.

The following compilations will give an approximate idea of the relative importance and extent of the exhibits from the United States, in Class 62, "Electricity," as compared with those from other countries.

The number of exhibitors in this class were as follows:

France, about	360	Chili	2
United States	28	Uruguay	2
Great Britain	19	Germany	1
Belgium	13	Japan	1
Switzerland	8	Luxemburg	1
Russia	5	Norway	1
Portugal	4	Finland	1
Austria	3	Argentine Confederation	1
Mexico	3		
Italy	2		
		Total	455

In a total of 455, France had 360, leaving 95 foreign exhibitors. Of these, the United States had 28, which is, therefore, about one third of all the foreign exhibits. England comes next, having one-fifth. France had 79 per cent. of the total number of exhibitors; United States, 6.2; Great Britain, 4.2; Belgium, 2.8; Switzerland, 1.8; Russia, 1, and the rest together, 5 per cent.

Of the fifteen members of the electrical jury, France had 10—Mascart (president), Potier (reporter), Deprez, Fontaine Fribourg, Huet, Postel-Viney, Sciama, Sebert, Trotin; United States, 2—Abdank, Hering: Great Britain, 1—Preece (vice-president); Switzerland, 1—Turettini (secretary); Belgium, 1—Rousseau. Besides this, there were five supplemental jurors; France had 3, Great Britain and Belgium, each 1.

The floor space occupied by our electrical exhibits was 967.25 square metres, or, in round numbers, about 1,000 square metres. That of the French section was about 2,000 square metres, not including the eight or ten stations distributed about the grounds for lighting. We, therefore, had about one-half as much floor space as France itself.

The floor space occupied by the other foreign countries cannot be determined with any accuracy, owing to the fact that the exhibits were together with numerous others, and were very much scattered about the grounds. From a rough estimate, however, it appears that Switzerland comes next, then Belgium and then Great Britain, the others being all quite small. The space occupied by the United States was about equal to, if not somewhat greater, than that of all the other foreign countries combined.

However, the importance of an exhibit is by no means proportional to the space it occupies Neither will the number of exhibitors represent the importance of an exhibit. These figures merely give an approximate idea of the extent of our exhibit as compared with that from other countries.

A better comparison of the real values of the exhibits may, perhaps, be had from the number and nature of the awards made by the jury, as that eliminates entirely the space occupied, and in a measure, also, the number of insignificant exhibitors. The awards made by the jury were as follows, in order of their value: Grand prize, gold medal, silver medal, bronze medal and honorable mention. Now, the mere total number of awards given to the different countries would by no means represent the value or importance of the exhibits from those countries. It is absolutely necessary, if any summation at all is to be made, to give the different awards some definite relative values. Such a relative scale is difficult to determine upon, as it is almost entirely a matter of opinion. Different persons have entirely different views regarding it, depending on what award they received or did not receive, as well as on the award which their neighbor received It is certain, however, that an arithmetic scale of relative values of 5, 4, 3, 2, 1, does not express the relative values of the different awards. The importance of the higher awards increases much more rapidly. A geometric scale of values would give a much truer value and, therefore, the following scale will be assumed here, as representing a fair average value: Grand prize, 20; gold, 10; silver, 5, bronze, 2; honorable mention, 1. By multiplying the number of the awards by their respective values on this basis, the totals obtained can then be assumed to give fair relative values.

The awards made to electrical exhibitors in the different countries, and their relative values on this basis, were as follows:

	Order of Succession.	Grand Prize.	Gold Medal.	Silver Medal.	Bronze Medal.	Honorable Mention.	Total Relative Values.	Total Relative Values in Percentage.	Percentage of Number of Exhibitors.
France	1	6	30	48	58	67	843	65.2	79.0
United States	2	4	6	4	2	2	166	12.8	6.2
Great Britain	3	1	4	4	3	2	88	6.7	4.2
Belgium	4	..	5	3	2	1	70	5.4	2.8
Switzerland	5	1	3	2	2	1	65	5.0	1.8
Russia	6	..	2	..	1	1	25	1.9	1.0
Germany	7	..	1	..	..	..	10		
Luxemburg	8	..	1	..	..	..	10		
Japan	9	..	..	1	..	..	5		
Uruguay	10	..	..	..	2	..	4		
Italy	11	..	..	..	1	1	2	Together, 3 per ct.	
Finland	12	..	..	..	1	..	1		
Austria	13	..	..	..	..	1	1		
Portugal	14	..	..	..	..	1	1		
Norway	15	..	..	..	..	1	1		
Total		12	52	62	73	78	1294	100	100

Together, 5 per ct.

It will also be seen from the above that the United States has one-fifth as much as France, twice as much as England, and about two and a half times as much as Switzerland and Belgium. It had four times as many grand prizes as any other foreign country, more gold medals, and as many silver, as any other. It received one-third of all the grand prizes, and about 12 per cent. of all the gold medals.

As far as awards are concerned, there were nineteen exhibits from the United States. Eighteen of these exhibits, or 95 per cent., were awarded, as in the above table; 21 per cent received grand prizes, 32 per cent. gold medals and 21 per cent. silver medals.

The awards were as follows (in alphabetical order):

Grand prize: American Bell Telephone company, Edison, Elihu Thomson, Elisha Gray.

Gold medals: American Graphophone company, Cobb Vulcanite Wire company, Heisler Electric Light company, Okonite company, Sprague Electric Railrway & Motor company, Western Electric company.

Silver medals: Commercial Cable company, Consolidated Telegraph & Electrical Subway company, Elektron Manufacturing company, Sperry Electric company.

Bronze medals: Electrical Supply company, Solar Carboo company.

Honorable mention: American Nickel Works (Wharton), Munson Lightning Conductor company.

Some idea as to the importance of the electrical exhibits, in comparison with the other exhibits from the United States, may be had from the number of grand prizes awarded in the other classes. There were in all fifty-three grand prizes awarded to United States exhibits; four of these, or 7.6% were for electrical exhibits. One class received nine; two classes, four: one class, three; five classes, two; twenty-three classes, one. But this is not a fair comparison, as twenty-seven (over half) of the grand prizes were for public institutions and government exhibits. Eliminating these, there remain twenty-six grand prizes to companies, manufacturers and inventors. Out of these, electricity was the only class receiving four, or 15.4 per cent. Four other classes received two each, and fourteen classes, one each.

Among the great successful inventions in the practical application of electricity, the United States may claim the telegraph, the telephone, the incandescent light and, unquestionably, the microphone[1] also; France, the accumulator and the Gramme ring; Italy, the battery and the Pacinotti ring; England, the self-exciting dynamo; Germany, the drum armature; Russia, the commercial arc lamp.—*Journal Franklin Institute.*

[1] Although Hughes made the invention in England, he had lived the greater part of his life in the United States and had obtained his whole education there, which led him to the invention.

Chicago Electric Club.

At the conclusion of Dr. Louis Bell's paper read before the Chicago Electric club on "Compounding Dynamos for Constant Potential" published in the last issue of the Western Electrician, the following discussion took place:

Professor Badt: If I understood Professor Bell correctly he said that the electromotive force should be kept constant at the terminals of the machine, and his formulæ were worked out on that basis. As a matter of fact we do not compound dynamos to keep constant potential at the binding posts of the machine, but we compound dynamos in order to keep a constant potential at the lamps. If, for instance, a 200 light, 100 volt machine should be so built as to keep a constant potential at the binding posts of the machine and we lose, let us say five volts in our conductors. It can readily be seen that in order to get 100 volts at our lamps we must run the dynamo at an electromotive force of 105 volts. If we now switch out 100 of the 200 lamps the loss in the conductors will not be five volts, but it will be two and a half volts. Therefore, it can be very easily seen that in compounding a dynamo for constant potential at the lamps we must know what is the percentage of loss, or the number of volts' loss in the conductors between the dynamos and the lamps, and the machine should be compounded for constant potential at the lamps, and a certain loss in the conductors. That is practically the way it is done. Now you can very easily see, that this introduces a new factor in the construction of the dynamo. We must know beforehand within very narrow limits, what the loss will be. Supposing a machine is compounded for the characteristic loss, say of five volts, and on the wire ten volts loss; that machine won't regulate. Or again, if we calculate on 2½ per cent. loss that machine won't regulate. The loss or the drop of volts in the conductor must coincide with the characteristic which we had in view when we compounded the machine. Now theoretically of course that thing looks very nicely but practically other elements come in. Suppose we have a perfectly compounded machine that will regulate, that will be automatic; that is to say, any number of lamps can be switched on and off and it will keep an even potential at the lamps with a 5 per cent. loss in the wire. Suppose now our wire man does not follow instructions very closely; they never do—and we find by actual testing we have 7 per cent. loss. Well, that machine will be out of place; what must we do? We must do something in order to get that percentage down to five volts, in order to make the machine run smoothly and regulate properly. In order to overcome that the early machines were always over-compounded; that is to say, if they wanted to run them for 5 per cent. loss, they were compounded for seven or eight, or even a higher loss. Then with the rheostat we cut down the effect of the series winding to a degree to make the compounding just harmonize with the loss on the wires, which we actually have—not that on which we calculate. That of course makes the thing a little complicated, and besides, of course, the rheostat causes an actual loss of energy and power; and after all, we don't get quite all the benefits of the compound wound machine that we should get. There is another point to be taken into consideration in a shunt and compound wound machine. We all know that the electromotive force of a machine depends upon the speed of the armature, all the other properties of the machine of course being the same; and in the shunt machine we have the rheostat in the field, an automatic regulator, and then must make up with the rheostat for the variations of speed in the steam engine, the water power or what ever power is employed. In other words if the speed increases the electromotive force increases and vice versa. Unfortunately we have no perfect power; that is to say there is no power which will give a uniform speed under varying loads. If the load on the engine is changed, the speed will change too. Now in that event, it has been found that compound machines are very much more sensitive to changes of speed than shunt machines. I know that compound machines are largely sold by various companies to-day, and I think it a benefit to a great extent, but people who buy them really don't get the full benefit of those wonderful theoretical demonstrations which agents will make to their customers. Compound machines are more complicated than shunt wound machines. When we send out laborers to set up plants they get along first rate with a shunt wound machine. But when they set up the compound machine they require assistance to get it right. It is much easier to connect shunt wound dynamos in multiple arc than to connect compound machines, and any man who has connected both will agree with me. So I have come to the conclusion from the theory of compound and shunt machines, and from practical experience as well, that I prefer the shunt machines if they are reasonably good. There has been a class of shunt machines which Professor Bell mentions, which are so bad that they won't regulate at all. They are compounded by their makers in order to make them regulate. That is a bad compound machine; it simply does not do what a well built shunt machine should do. It is merely a make shift. It is simply compounded because the man who made it didn't know how to make a good shunt machine.

Professor Bell: In reference to two or three points that were called out I hardly agree with Prof. Badt, I do not think it is either practical or desirable to make a bad shunt machine into a compound, but I think a good shunt may sometimes be made into a better compound machine. Regarding one point, the trouble with loss and leakage, I don't know whether it is the proper method or not but it is very clear that if we are working with no loss in leakage, with the dynamo going up two or three revolutions, or lowering two or three revolutions, it will do precisely the same thing that is done with the various shunt parts, and probably will do it just as well. If the shunt coils have a rheostat, as is the case in very many machines, and we are not able to shift the compounding by that means, and if, for instance, a little more loss in the leads must be accounted for, a change of revolutions, because compound machines are sensitive to a change of a very few revolutions, will make up for the loss in the leads, and the lowering of the speed by a very few revolutions would make up for the decreased loss, if it was less than was expected. But I am not sure but that would be a very good practical way of doing it.

Professor Badt: You can make up for the loss, of course, but you don't get any more straight lines for varying current; you get a curve there.

Professor Bell: I should think you could get very

fairly good regulation provided you did not have two lines to work over, say a change of from 2½ to 5 per cent. There is just one point I would like to call attention to now, and that is where the changes are so rapid; I have seen shunt machines in railway work go from 485 volts down to 105, and back again, before you could count ten That is one place where the compound wound machine has a very decided advantage

MR. KAMMEYER: I heard Professor Bidt and Professor Bell state that a variation of speed of compound machine would affect the compounding. Now that is totally at variance with my experience. Some time ago I saw the question asked in some periodical why a compound machine will compound tolerably well at various speeds. That statement seemed to me to be remarkable, so I thought I would try it, and I did; I changed the speed of the machine that was compounded fairly well. It didn't change over two and a half to three volts between full load and no load. The full load was intended to be 125 to 130 amperes. I ran it at a speed of 1,150, then ran it at 1,200, and found instead of 104 volts that the machine had been compounded for, it ran up to 107, and throwing on and off the load, the variation in the voltage was only two or three volts, the same as it had been with its proper speed of 1,150. I then ran the speed down to 1,100, to 1,050 and to 1,000, and with 1,000 it only gave 85 volts, when with full load it would give for instance 85 volts, and with no load it would give 87 to 88 volts. There was a little trouble as the speed was not quite constant, but otherwise it compounded just as well at any of those speeds as it did at its proper speed. Now if any of you gentlemen will explain that, I will be very thankful.

PROFESSOR BELL: Of course it is a machine that had not been compounded very well to start with. I don't know what the actual nature of the variation was; that is to say, whether the machine gave an equal potential at no load and at full load, rising between, or whether it dropped off.

MR. KAMMEYER: With full load the potential was say two and a half or even three volts less than what it should have been, which would indicate that it didn't have quite enough series turns.

PROFESSOR BELL: It probably fell down about three or four volts; I should say that the place to look for the explanation of that sort of a performance was in the change of the saturation of the magnets. I think if the magnets were nearly saturated, it might be possible, for instance, that at any rising speed you would not have the same trouble with the compounding that you would if the magnets had not been nearly saturated. I should look first for the effect on the magnetic qualities of the machine.

MR. KAMMEYER: That brings me to the point that I was going to ask about when Professor Badt asked a question; that is to accurately determine the quantities, q x and q. If you will give those two quantities I think we could compound it all right.

PROFESSOR BELL: Those two quantities can be obtained very readily if you know approximately even the quality of the iron. At the same time you could get a sufficiently close idea, I think, by a knowledge of the published characteristic. After you have tried a number of experiments with the iron you can hit close enough the average values to arrive at the total induction.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 11.—The Board of Electrical Control continues to drop lower and lower in public favor. Mayor Grant has lost all confidence in the commission and his disgust was evident at the meeting of the board a few days ago. In his message he points to the fact that electrical experts should occupy the positions now held by the political bosses who are associated with him in the commission. Of the work of the board, the mayor says: "Since the first of January, 1889, the bureau of incumbrances has removed 2,495 poles, and about 14,500,000 linear feet of electrical wires. The public authorities have recently felt compelled to remove from the streets wires which were believed to be dangerous to human life. By this action some portions of the city were deprived of the use of electric lights. The interruption of this service will, however, be but a temporary one. Already subways have been constructed in some of the leading thoroughfares, and it is hoped that sufficient will be constructed during the coming year to accommodate the entire electrical industry in the city." In order to do this, however, it will be necessary to take the exclusive franchise for the construction of conduits away from the subway company which has proved utterly incapable of performing the work.

The utter failure of the Board of Electrical Control of New York to solve the question of disposing of the electric wires in the metropolis has aroused the press and public to call upon the legislature to repeal the act under which the board was organized and wipe out that institution entirely. All who have followed the course of the board will agree that there is sufficient cause for this outburst of popular indignation. The New York *World* says: "For over four and a half years New York has been paying three commissioners $5,000 a year each for supervising technical work of which they possess no knowledge, and regarding which they have made no effort to acquire any practical information. These commissioners comprise the Board of Electrical Control. They obtained their positions through a 'deal,' and have devoted their time and such talents as they possesess to showing how not to bury the electric wires. But they have devoted considerable energy to efforts to persuade the public that they are anxious to bury the wires and lose their $5 000 jobs, but have been prevented by bad men from carrying out their plans." The law under which the board is acting was passed Nov. 14, 1884, by the New York legislature. Neither the subway commissioners who were first appointed nor the Board of Electrical Control which succeeded them have performed the work intrusted to them, and this leads to the following comparison of results: "This law is practically the same as the one under which the wires were buried in Chicago, the only city in this country where they are really buried. Not only are they buried in Chicago, but they are so well buried that the president of the Chicago Arc Light & Power company has voluntarily made an affidavit in which he takes issue with a suggestion that 'no commercially practical method' has been devised for burying high tension circuits. He says his experience 'indicates that it is possible to furnish electric light service by this method, both from a commercial and scientific standpoint.' In fact, the work of burying the wires in Chicago has apparently been accomplished to the entire satisfaction of all parties concerned. Chicago had no Subway Commission or Board of Electrical Control at $15,000 a year, but the work was done under the supervision of Prof. John P. Barrett, city electrician, whose salary scarcely exceeds that paid by the New York Board of Electrical Control to its alleged expert adviser."

The work has progressed very slowly indeed and when, in order to mislead the public, the commissioners ordered the wires cut there was no way of conducting the business of the electric companies, as there were no conduits in which to place the wires. It is a curious fact that when the wire cutting and pole chopping was begun there was not a conduit accessible to any electric light or power station in New York, yet the work of destruction was commenced at the very doors of these companies. A review of its work is certainly anything but edifying. The New York *World* says: "The Board of Electrical Control instead of doing the work for which it has been paid has delegated it to others and sought to silence public clamor by making buncombe pretenses of seeking to bury the wires. In Chicago an experienced electrician, unhampered by a Board of Electrical Control, buried the wires so satisfactorily that even the electric light companies avail themselves of every opportunity of praising his work, and his salary is not one-fifth of that paid the three Subway commissioners and only a fraction of the sum New York pays for engineers, experts and others to assist its ornamental board of wire-pulling politicians."

As has been already stated in the WESTERN ELECTRICIAN, changes have been made in the Sprague Electric Railway and Motor company. E. H. Johnson resigns the presidency and J. H. Herrick has been selected to fill the vacancy. Samuel Insull is elected vice-president. Acting Manager Sprague continues as executive officer and chief electrician As before stated, the entire stock of the Sprague company is purchased by the General Edison Electric company.

The Electric Gas lighting company has removed to more spacious quarters at 195 Devonshire street and occupies the large store and basement extending through to Arch street. Mr. Barnham reports excellent business.

R. J. Steen has been appointed general agent for the Cobb Vulcanite Wire company with offices at 45 Broadway, New York.

The horse race in the last act of the "County Fair" now playing at the Union Square theater is ingeniously devised and the effect truly realistic. The fence in front of the race track moves at the rate of 20 miles an hour and the horses are running like mad behind the fence on a treadmill reduced to a level. This device is kept in operation by electric motors underneath the stage.

This city is in a bad way to handle crowds, and should the World's Fair be held here it is probable there will be a repetition of the experience at the Paris Exposition, due to lack of rapid transit facilities It is now too late to build elevated roads, and the present system is overtaxed with the ordinary demands upon it. The only hope left is in the adoption of the electric system on surface roads, and largely increasing the rolling stock. W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Jan. 13.—All the street cars in Minneapolis and St. Paul are to be operated by electricity with the exception of the Selby avenue line in St. Paul. The cable system which was projected, will be abandoned, although construction had commenced and material was on hand. This decision was practically reached by Mr. Lowry on Thursday night after conference with Mr. Goodrich and others, but it was not until Saturday that he definitely announced his intention. The consideration that led to the decision was the satisfaction which the Fourth avenue electric line has given in Minneapolis. A strong pressure was brought to bear upon the street railway president by citizens who saw in the new motive power the greatest possible merit. Ever since the line began to work smoothly they have overrun Mr. Lowry's office to tell him how greatly pleased they were, and what a mistake he would make should he put in cable power instead of electricity on the other lines.

The Fourth avenue line has worked splendedly in cold weather and in a heavy snowstorm. Mr. Lowry is quoted as saying: "We have come to this decision because we believe it to be for the best. The people seem to be thoroughly pleased with the electric line on Fourth avenue. We have given it a fair test and believe it to be the very best motive power we can put into our system. We stand ready to put in whatever system the public wants, and we believe the electric system will fill the bill better than any other. I did not believe that it would be successful when first put in, but I have been obliged to change my mind. If we thought the public would rather have the cable lines we would put them in, but we believe the public prefers electric lines and would be benefited by them. Then, too, it would be better to go ahead with the change now, before any further expense is incurred for the cables. We shall sink a good deal of money in the work already begun, but there is no use crying over spilt milk. It seems to be for the best. The change of the whole street railway system to an electric one would not conflict with the proposed transfer system, and one may ride from one end of the city to the other without extra cost, just as was originally contemplated. Provided the Minneapolis council gives us consent, we shall push the work as fast as we possibly can All the cable line work which was mapped out for this year will be finished at the time agreed upon, but with electricity. Then we shall also do as much work on the other lines as we can, and get them in shape in the speediest manner possible." Mr. Lowry said that the loss to the street railway company, should it abandon the cable lines, would be about $400,000. The two power houses and some of the track have already been put in, and a great amount of material is already on the ground.

Regarding St. Paul, Mr. Lowry said that the matter of a change in motive power there was a very simple one. The St. Paul council had given him the privilege of using whatever power he pleased, electric or cable, on the lines so specified in the ordinance lately passed. Accordingly he had selected the former power, and it would be put in as soon as possible. General Manager Goodrich is also quite enthusiastic on the subject of electricity as a motive power. He believes it will be a big success. He said: "The people like the electric line. It is much less noisy than the cable; it is smooth running and rapid. We handled the last big snow on the line better than we ever handled snow with horse cars."

It is estimated that there will be about one hundred miles of electric street railway in Minneapolis should Mr. Lowry's proposition be acted upon favorably, and nearly the same amount in St. Paul. D.

St. Louis, Mo.

ST. LOUIS, Jan. 11.—The people of this city had an important fact impressed upon their minds this week. It was the necessity of a thorough overhauling of electric wires in this city, the cutting down of improperly insulated wires and the removal of the numerous dead wires from buildings and poles about the city. The havoc created among the wires by the heavy sleet storm of this week opened the eyes of the electric companies. As a matter of protection to their business interests they cannot disregard public sentiment so much as to neglect to place their wires in good condition at the earliest possible moment. The network of wires sagged under the weight of ice and snow that fell Monday and Tuesday, and in many instances proved too heavy, breaking the lighter wires and leaving them dangling in the streets. Pedestrians kept clear of these wires, but an unlucky team came in contact with one of these wires which crossed an electric light wire, and they were instantly stricken down. The report of this accident increased the fears of the people and they clamored all day to have the dynamos in the electric light stations shut down. This was done in the case of the plant that supplies current to the incandescent lamps which illuminate the alleys and public buildings, but the commercial lamps were continued and no accidents were reported The messenger, telegraph and telephone companies were great sufferers. Their wires were burned out by contact with the electric light companies' lines with which they came in contact, and of course the service was greatly crippled. But

the greatest damage was that sustained by the Fire Alarm and Police Telegraph department. It was estimated that at least 150 fire alarm boxes were made entirely useless between midnight Tuesday night and noon Wednesday. The blame partly rests with the electric light companies, but a large share of the damage was caused by the circuits being broken by the sagging of the wires resulting from the heavy sleet. The fire alarm linemen are compelled to work like beavers to keep the boxes and wires in condition. On several occasions arc light circuits crossed fire alarm wires, and as soon as the electric lights were turned on, considerable trouble was entailed on the fire alarm department. The present condition of the fire alarm is a serious matter indeed. A fire may originate in a large business block and the fire-alarm box would refuse to carry in an alarm, thus delaying the arrival of the Fire Department.

The machinery and all appurtenances of the new electric railway over the big bridge were for the first time fully tested by the storm Wednesday. The snow was removed from the grade on the east approach to the bridge, and the car then moved along nicely. Passengers were accommodated with very little inconvenience. Many have contended that the first storm, if it did not directly retard the progress of the car, would interfere with the wire to such an extent that a total suspension of business would be necessary, but such was not the case, although the storm was as severe as may be expected in this section.

Not only the telegraph but also the telephone service to towns near by was cut out temporarily after the fire in the Western Union office. At 8:30 A. M., Wednesday, the manager of the Western Union office at Belleville, Ill., published a bulletin that the Western Union building in St. Louis had been burned out, and that telegraphic communication with St. Louis was interrupted. The dispatch came by way of Kansas City to Chicago, then to Cairo and to Du Quoin by Illinois Central wires, and then by Western Union to Belleville. It was the first time since the telephone service had been established in Belleville, six years ago, that both the telegraph and telephone service were out of order at the same time. At 1:16 P. M. by strenuous labors a connection was made with St. Louis.

An order has been issued directing the Board of Public Improvements to remove all dead wires within the city limits. F.

Council Bluffs.

COUNCIL BLUFFS, Jan. 11.—The motor company made extensive improvements during 1889. During the past year the company has extended its line to the head of Broadway, with lateral branches to Fairmount park, the local depots and the Union Pacific transfer. Regular and frequent service is given in connection with the main line, bringing residence property in neighborhoods heretofore inconvenient to reach, within easy access of business.

The company now has between eighteen and twenty miles of road in operation. The capacity of the boiler, engine and dynamo plant has been more than doubled, and the equipment of cars and motors of Pullman's latest design, handsomely upholstered, lighted by electricity and heated, has also been nearly doubled.

Another electric line is projected for 1890. This will be practically a belt line giving first-class service to rapidly populating sections of the city. The line will extend to the city limits on the south and east. A charter has been granted, and as enterprising and energetic citizens are behind the scheme it may be relied upon that another year will see the line completed and in active operation. H.

Boston, Mass.

BOSTON, Mass., January 10.—Mayor Hart has awarded the contract for lighting the streets of Boston by electricity for a period of five years to the Suburban Light & Power company, at the following rates: For the city proper, South Boston, West Roxbury and Dorchester, 39 74-100 cents per lamp per night; for Roxbury, 37 99-100 cents per lamp. This award was made yesterday afternoon and has been the favorite topic of discussion by electric light men to day. This morning the Charlestown Gas company put in a bid of 40 cents per light for the Charlestown district and the contract for five years was at once awarded to that company. Its last bid, on Nov. 29, was 50 cents per light. Early in the week the contract for the Brighton district was awarded to the Brookline Gas Light company for a period of five years at 40 cents per light per night. The cost to the city at these prices is estimated to be about $73,000 less per year than at the old contract price paid to the Boston Electric Light company. Although the city's contract with the company expired at noon on Tuesday, arrangements were made by the mayor whereby it will continue to furnish lights at the same price as heretofore, until the city can be provided for in some other way. The Suburban Light & Power company has neither plant nor location, but it has agreed to have its lights burning in Roxbury, West Roxbury and Dorchester in six weeks, in South Boston in twelve weeks, and in the city proper in sixteen weeks. It is expected, however, that the Boston Electric Light company will contest the right of the Suburban Light & Power company to do business in the city, although Mayor Hart asserts that both the corporation counsel and the state gas commissioners have assured him that the company does possess that right. The directors of the Suburban company are C. H. Clapp, A. C. Burrage, Hon. A. W. Tufts, W. A. Paine and Frank Ferdinand, all well-known Boston business men. The company has a paid-up capital of $75,000, which it proposes to increase at once to $250,000. It is now stated that P. H. Alexander, the general manager of the Sawyer-Man Electric company, has largely aided the company in its efforts to secure the contract, and that George Westinghouse, Jr., will lend his personal and financial aid to the work of establishing the necessary plants. In fact, it is asserted that it will be a Westinghouse plant, and that special attention will be given to incandescent lighting.

It is now an open secret that Mayor Hart would like to try an experiment with a municipal plant of about 100 lights capacity. In the common council last night an order was offered and passed requesting the superintendent of lamps to submit to the city council an estimate of the cost of establishing and maintaining an electric light plant in the city, and a report on the expediency of maintaining such a plant at the city's expense.

Under the head of street lighting the mayor of Lynn, Mass., in his inaugural address this week says that the present lighting service of that city comprises 151 arc and about 950 incandescent lights, and he recommends that both should be burned all night, in order to add not only to the public convenience and safety, but to the efficiency of the police service.

In the Massachusetts House of Representatives yesterday a petition was received from the Gloucester, Mass., street railway for permission to operate its road by electricity.

Pending the action of the legislature and the aldermen in providing for the control of the overhead electric wires, the Boston Board of Fire Underwriters has concluded to make a series of tests of various styles of safety fuses and the board announces that any device of this character sent to its office at 55 Kilby street will be carefully tested. It is probable that those which pass the best tests will be recommended for general adoption on overhead circuits at the points of entrance to buildings.

Treasurer Weld of the Edison Phonograph Toy Manufacturing company, has just returned from Mr. Edison's laboratory at Orange, N. J. He is reported as saying that affairs there in connection with the doll industry look more like business than at any previous time. The factory is stocked with parts of the doll, and these will be put together at once. Mr. Edison made a delivery of fifty dolls to the company on Jan. 3, and Mr. Weld asserts that within two months there will be a large stock of dolls on the market.

The New England Electric company, New England agents for the Sprague motors, has established an agency at Lynn, Mass., at No. 2 Sea street. J. W. Upp, formerly with the Robinson-Foster Motor company, is the agent.

E. W. Rice, Jr., superintendent of the Thomson-Houston Electric company's factory at Lynn, has been a victim of "la grippe" this week. He was not alone, however, as about 250 of his employes were off duty from the same cause, and at the works of the the Thomson Welding company fifty employes were similarly affected.

At a meeting on Wednesday of this week the executive committee of the Thomson European Welding company voted to send Elmer Howe, a patent lawyer, to England to close up the contracts in that country and receive payment. He will be accompanied by Mr. Boland, an officer of the company.

The West End company's snow sweepers, one of which was well illustrated in the last issue of the WESTERN ELECTRICIAN, are out again to-day doing good work keeping the tracks clear after the light snow which kept falling all the forenoon to-day.

The inauguration dinner of the Boston Electric club took place at Young's Hotel last Monday evening, over fifty members taking part in the proceedings. Count Zuhoff, James F. Meech, European agent of the Thomson-Houston Electric company; Dr. A. De Bausset, of air-ship fame; Col. B. S. Lovell, Arthur Lord and others, were present as guests of the club. O. H. M.

Detroit.

DETROIT, Mich., Jan. 11.—The city council on Monday awarded to the Detroit Electric Light & Power company the contract for lighting the city for three years from July 1 next. The Brush company, which has held the public lighting contract for a number of years, secured an injunction to prevent the council from taking action, but the president refused to notice the document, declaring that he would pay no attention to papers served upon him while the council was in session. The injunction was temporary, and restrained the council from entering into a contract with the Detroit Electric Light & Power company to furnish the public lighting, and was issued by Judge Hosmer on the affidavit of the Brush Electric Light company, James L. Edson, Clarence A. Black, Allan Bourn, David O. Paige, William H. Elliott and Wells W. Leggett, which set forth that the bids of the Detroit company were illegal because not accompanied by drawings and specifications; that the Brush company owned letters patent for the double carbon lights which the former purposes to use, and that if the bid was accepted the city would be sued for infringement on rights of the Brush company.

The Detroit company's bid was about $9,000 under that of the Brush company. The matter promises to give rise to a long and bitter fight. B.

THE ELECTRIC LIGHT.

The Burlington, Ia., Gas company has just installed a 35 light Thomson-Houston dynamo.

Arrangements are being made to supply Laredo, Tex., with 100 arc lights and 2,000 incandescent lamps in addition to the 1,500 electric lights already in use.

H. M. Sciple & Co. are just starting a 100-horse power tandem compound Ball engine at the station of the Edison Electric Illuminating company of Lebanon, Pa.

The Sperry Electric company of Chicago, has completed its installation at Council Bluffs, Ia., and the plant has been accepted by the Gas & Electric Light company of that city.

The California Electric Light company of San Francisco, Cal., recently purchased a 100-horse power tandem compound engine from the Ball Engine company of Erie, Pa., for its station.

The town of Tecumseh, Nebraska, has ordered through the Omaha Engineering company, of Omaha, Neb., agents of the Ball Engine company of Erie, Pa., a Ball engine to run its electric light plant.

The Minonk, Ill. Electric Light & Power company, has been incorporated to furnish light, heat and power; capital stock, $15,000; incorporators, M. L. Newell, A. B. Knipp, and G. W. Weber.

The Macomb Electric Light & Gas company at Macomb, Ill., has been organized to furnish light, heat and power; capital stock, $25,000; incorporators, Charles Ketteron, H. W. Cummings and J. N. Rume.

In Cincinnati last week the question of putting arc wires underground was referred to a committee of five from the councilmen, five from the aldermen, the five members of the Board of Public Affairs and the city solicitor.

In the House of Representatives last week Representative McComas made an effort to have a resolution adopted ordering all electric light companies in Washington to put their wires underground. The measure was not passed.

The Allegheny County Light company of Pittsburg, Pa., has ordered two arc light machines, Westinghouse new system, 60 lights each, of the Westinghouse Electric company. This gives the Allegheny County Light company a total capacity of 800 arc lights.

A writer in the New York *World* speaking of underground systems says: In London the practice has been to lay the cables directly in the earth or in iron boxes situated about twenty inches below the surface of the sidewalk, it being considered preferable to break up the sidewalk than to disturb the surface of the street. In Paris the cables are likewise stretched beneath the sidewalk in a single duct provided for them. The cables commonly employed are known as those of the manufacture of Siemens, of Berlin, and Berthoud & Borel, of Switzerland. In various Continental cities I noted the cables were placed in conduits of Beton, the practice being to stretch the cables on a form and subsequently construct the conduits around the cables by tamping the cement. By this arrangement no gas can find its way around the cables, the danger from explosion of accumulated gas is thus avoided, and the cables themselves are protected from mechanical injury.

THE ELECTRIC MOTOR.

An extensive street railroad system is contemplated by capitalists at Oakland, Cal. It has been decided to introduce electricity as the motive power.

The Citizens' Horse Railroad company of Belleville, Ill., has been granted a franchise to change its motive power to electricity. The mayor has approved the action of the city council and work will be begun immediately.

The Sprague Motor line, at Laredo, Tex., which commenced operations four weeks ago with four miles of track and six passenger coaches, has been crowded with business to such an extent that the company has found it necessary to double its plant and lay increased mileage of track.

The Consolidated Street Railway company of Toledo, O., has decided to substitute electricity for horses on all its lines. The company is anxious to secure an economical storage battery system, and is now experimenting in that direction. Should it fail to meet with the desired results, an overhead system will be introduced. At any rate, the

company promises to have all its lines operated by electricity within a year, and to extend the system to East Toledo.

San Francisco, Cal., capitalists are looking for a franchise to build an electric street railroad on the following streets of that city. Commencing at Seventeenth street, where crossed by the Northern Railroad company, to Center street, to Sixteenth, to Grove, to Thirteenth, to Oak, to Twelfth, to East Twelfth, to Thirteenth avenue, to East Fourteenth street, to Fifteenth avenue, to East Fifteenth street, to Twenty thitd avenue, also commencing on Eighth street at Cedar street, easterly to Grove street, to Thirteenth street.

The Westinghouse Electric company has entered the field of supplying electric machinery for mining purposes. A few days ago the company secured a contract from the Hercules Mining Machine company of Pittsburg, Pa., for a large number of motor generators and Tesla motors. The apparatus is to be used to operate the Hercules coal mining machine, a new device, which has lately been brought out by the Hercules Mining Machine company. The Hercules is said to possess the ability of producing coal on a most economical plan. The Hercules is being introduced in the coal mines of the Monoogahela valley, and a Tesla motor goes with each Hercules.

THE TELEGRAPH.

An action for $10,000 damages has been begun by Joseph E. Carle of Petroleum, Pa., against the Western Union Telegraph company for non-delivery of a message.

The South Brunswick, Ga., Telegraph, Telephone, Electric Light & Water company has been incorporated to construct and operate telegraph and telephone lines, water works and electric light plants. The capital stock is $50,000.

The Chicago Board of Trade practically suspended business last Monday owing to the havoc caused by the wind storm Sunday night. Wires were down in all directions and connection with many important points was temporarily cut off.

Miscellaneous Notes.

The official report of the eleventh meeting of the National Telephone Exchange association at Minneapolis, has just been published in pamphlet form.

The Anaconda mine which had been closed since the great fire Nov. 23d, was reopened Jan. 8th and as soon as possible operations will be begun.

Secretary Pope of the American Institute of Electrical Engineers, reports that since the publication of the revised catalogue last November, 29 associate members have been elected.

The Columbia Electric company, at Chicago, has been organized to do a general electrical business; capital stock, $1,500,000; incorporators, A. P. Willoughby, N. H. Hanchett and N. O. Hunsberger.

Business Mention.

The Holtzer-Cabot Electric company of 111 Arch street, has issued a calendar for 1890 of an unusually handsome design.

The Electrical Supply company of Chicago has just issued a complete list of fuse wire. The company is selling large quantities, and it is giving splendid satisfaction.

The Sprague Electric Equipment company, Chicago, has just issued an interesting catalogue descriptive of electric railway supplies. It also contains considerable valuable information in this important department.

J. H. Shay of the Munson Belting company, has just closed a contract with the Central Electric Railway company of Peoria, Ill., to furnish it a 42-inch belt to run its main shaft, and 312 feet of 12-inch belt to run its generators.

J. W. Marsh, secretary of the Standard Underground Cable company of Pittsburg, will shortly assume the entire management of the business of the company, it is understood. It is well known that Mr. Marsh has, been the leading spirit in this successful enterprise, and to his untiring efforts may be attributed the remarkable progress that has been made. The success which has thus far attended his efforts warrants the confidence placed in him by his associates. Mr. Marsh's friends wish him continuance of the good fortune he has thus far enjoyed.

The year which has just closed has been the most eventful in the history of the Westinghouse Electric company. The business done during 1889 surpassed anything ever anticipated. The company has now 266 central stations distributed throughout the country and abroad, which are fitted with Westinghouse alternating current apparatus. The contracts for 134 central stations were secured during last year, making the business of that period exceed the combined amount of the previous years since the organization of the company in 1886. These 134 central stations represent an aggregate capacity of 234,250 incandescent lamps. This does not include the various increases, which were also contracted for by various companies already established. To show the enormous growth of the concern, the following comparative facts may be interesting: In January, 1889, the company employed 650 men in its works on Garrison alley, Pittsburg, Pa. During this year, however, many improvements were necessitated, and to-day the company employs 1,300 men in Pittsburg alone. A new building of five stories was built during the year for the detail department, a pottery and a laboratory. In the detail department the alternating current meters are made. The production of that article has increased 400 per cent. during the year. In the pottery, which, by the way, is a complete factory, switches, cut-outs and other devices are made. The laboratory has been fitted up with all those requisites which make a place of that kind perfect, and the Westinghouse laboratory is now considered by those who have visited it the finest and most complete in the country. The machine shop has been repeatedly enlarged to meet the demand made upon it by the increased number of contracts. Several new engines were put into the building, and a new battery of boilers consisting of two Babcock & Wilcox boilers, 500 horse power each. The lamp factory of the company was removed during the year to New York to give more room to the converter department. In March, 1889, the company started in the arc lighting business by absorbing the Waterhouse Electric & Manufacturing company of Hartford, Conn. They gave a fresh impetus to that business, and the number of Waterhouse machines sold since then has been large. During the year the company also established a branch in London, Eng., for the purpose of taking care of the European business, and the accounts received from there are very promising.

Personal Paragraphs.

E. S. Hewson of the Westinghouse office, Chicago, is seriously ill.

J. W. Marsh, secretary of the Standard Underground Cable company, Pittsburg, was in Chicago last week.

C. D. Shain of the United Edison company of New York, was a visitor at the Chicago Electric club this week.

H. O. Woodruff, general agent of the Hawkeye Electric Manufacturing company of Davenport, Ia., was in Chicago last week.

F. G. Beach, presideot of the Chicago Electric club, who has been seriously ill, has sufficiently recovered to attend to his business duties.

The committee formed at Manchester, England, has decided to erect a white marble statue of the late Dr. James Prescott Joule as a companion to that of the late Dr. Dalton by Sir Francis Chantrey, and also a replica in bronze to occupy some public place in the city. A large number of subscriptions have been already promised.

Electrical Patents.

Issued Jan. 7, 1889.

418,678. Electric Switch for Motors. Harry H. Blades, Detroit, Mich.

418,682. Ear Phone Rest. George E. Christie, Paterson, N. J.

418,685. Brush Holder for Dynamos. Peter Claus and Eugene Gengenbach, New York, N. Y.

418,700. Secondary Battery. Harry E. Dey, New York, N. Y.

418,701. Cut-Out for Secondary Batteries. Harry E. Dey, New York, N. Y.

418,702. Cut-Out for Secondary Batteries. Harry E Dey, New York, N. Y.

418,703. Method of Forming Secondary Battery Plates. Harry E. Dey, New York, N Y.

418,704. Bracket for Supporting Electric Conductors. John A. Duggan, Quincy, Mass.

418,718. System of Transportation. Benjamin S. Henning, New York, N. Y.

418,748. Distribution of Electricity by Secondary Batteries George B. Prescott, Jr., Newark, N. J.

The invention contemplates the use of a primary generator of electricity located at a central station, and one or more sub-stations, at each of which there is located a secondary battery and a working circuit to be supplied thereby. The main and sub-stations are to be connected by two or more main leads, called the 'charging circuit."

418,757. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill.

Claims seven and eleven read:

"7. In a double carbon arc lamp a support for the lower carbons, consisting of two insulated sections, one section for each of the carbons.

"11. In a double carbon electric arc lamp, two carbon rods, each provided with clutch mechanism for lifting and feeding the same, and electro-magnetic devices in the main circuit and in the shunt of the arc, in combination with retaining mechanism to carry and hold out of use one of said carbon rods and its clutch mechanism while the other carbon rod and its clutch mechanism are carried and fed by the said electro-magnetic devices."

418,758. Electric Arc Lamp Charles E. Scribner, Chicago, Ill.

418,766. Support for Electric Conductors Joseph B. Smith, Manchester, N. H.

418,775. Belt Gearing. Charles W. Wall, Buffalo, N.Y.

418,778. District Telegraph Alarm Box. Charles G. Armstrong, Englewood, Ill.

The claim follows:

"In a district telegraph signal box, the combination, with a revoluble commutator wheel having a series of recesses in its periphery, of a brush and the wires of a divided circuit, one of said wires being connected to the brush and the other of said wires consisting of several separate sections and suitable circuit closers connecting said sections, which are normally disconnected from the commutator wheel, but are engaged by the same in the course of its rotation."

418,824. Lightning Arrester. Elmer A Sperry, Chicago, Ill.

The inventor says:

"The 'word' circuit is thought preferable in connection with this case, inasmuch as it is always used to indicate the path of a current. It is herein used for this identical purpose and to indicate that path of the current which includes also the open space between the discharge plates."

Of the fifteen claims the twelfth is given:

"In a lightning arrester, the combination of a pivoted movable discharge plate with a piece which normally holds the same away from the fixed discharge plate, a fusible conductor which engages such piece, and a series of circuits, one including such fusible conductor and another such pivoted discharge plate."

418,837. Battery Carbon. Charles G. Armstrong, Chicago, Ill.

Claim one reads as follows:

"The combination, with the circuit wire and the carbon, consisting of a cup and a cover integral therewith, of the knob or extension on said carbon cover and a surrounding band to which the circuit wire is attached."

418,843. Means for the Electrical Propulsion of Vehicles. Delbert E. Johnson, Atlanta, Ga.

418,850. Cable Railway Signal. John H. Pendleton, Brooklyn, and Andrew Bryson, Jr., and Cornelius Tiers, New York, N. Y.

418,853 Electric Motor or Generator. Imle E. Storey, Boulder, Colo.

The field magnets are included in a laminated ring. They consist of four spools radiating from the center and bolted to the inside of the ring.

418,855. Incandescent Lamp Holder. Imle E Storey Boulder, Colo.

418,856. Carrier System. Imle E. Storey, Boulder, Colo.

The fourth claim is:

"In a carrier system a tube divided into sections, an electric motor for and adapted to drive each section, an electric circuit including each motor and switching devices, whereby each motor may be cut in and out of circuit."

418 868. Annunciator. Julius Finck, San Francisco, Cal.

418,871. Electrical Indicating Apparatus. George A. Holt, Oakland, Cal.

The object of the invention is to provide for the electrical transmission of the readings or record of one indicator located in a given position to one or more indicators located or distributed at convenient points, whereby the condition of the first named indicator may be readily seen without examining it directly.

418,889. Electric Deep Sea Sounder. Alfred J. Cooper and Eustace E. Wigzell, London, England.

418,893. Electrically Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa.

418,910. Electrical Signal Operating Device. Charles A. Cox and Joseph F. Cox, Louisville, Ky.

418,911. Electric Heating Apparatus for Electric Railway Systems. Mark W. Dewey, Syracuse, N. Y.

The dynamo is located on a vehicle or car or one of the cars of a train, and is driven or operated by the same source of energy that moves the car. In some cases a separate motor from the propelling motor drives the dynamo. In other cases the propelling motor drives it. The heating circuit leading from the dynamo is of very low resistance and includes one or more electric heating devices.

418,912. Method of Transforming and Utilizing Electrical Energy. Mark W. Dewey, Syracuse, N. Y.

The tenth claim reads:

"The method of transformation or conversion of electrical energy, consisting in charging a member of a condenser with electricity, and simultaneously therewith and thereby charging a member of a condenser with electricity of different tension, and then discharging both members."

418,987. Electric Arc Lamp. Edwin C. Russell, Skowhegan, Me.

The last claim is appended:

"5. In an arc lamp, the combination of a magnet, an armature, a weighted arm supporting said armature and operating to automatically maintain it in its relative attractive position to said magnet, a rotatable disk of carbon, and pawl-and-ratchet devices operating through the medium of said magnet and armature to cause a rotation of said disk."

419,013. Electric Belt. Charles H. Grimley, New York, N. Y.

419,032. Method of Welding by Electricity. Charles L. Coffin, Detroit, Mich.

The process consists in electrically welding metals together in a non-oxidizing medium.

419,033. Method of Electric Welding. Charles L. Coffin, Detroit, Mich.

The method consists in pressing together the two pieces to be welded, traversing the point between the two pieces by an electrical current, and submitting the joint to the influence of a magnet acting across the line of the current.

419,059. Electric Motor. Harry B. Niles, Union Springs, N. Y.

419 068. Electro-Mechanical Time Stamp. Charles A. Randall, London, England.

419,094. Apparatus for Propelling Vehicles by Electricity. Frank Wynne, Westminster, England.

419,111. Insulated Nippers. Firmin M. Casey, Mount Vernon, N. Y.

419,166. Electro-Magnetic Transmitter. John T. Williams, Mount Vernon, N. Y.

11,053. Electric Pen Holder. Charles W. Reitler, Denver, Colo.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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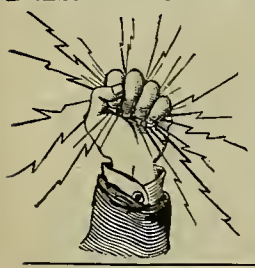

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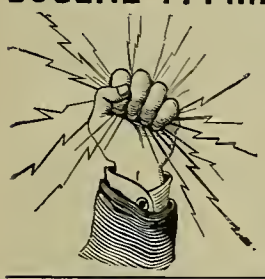

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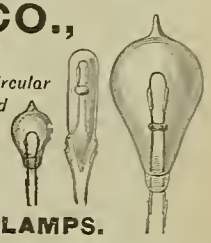

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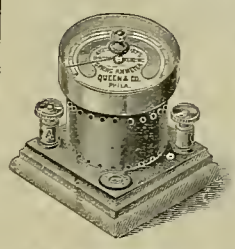

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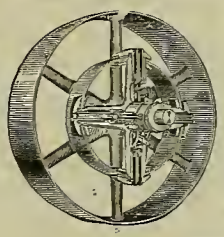

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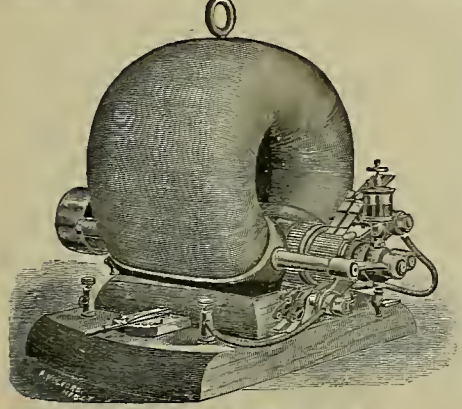

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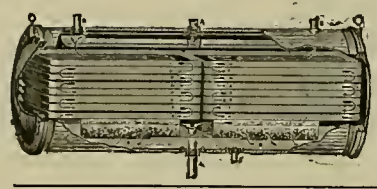

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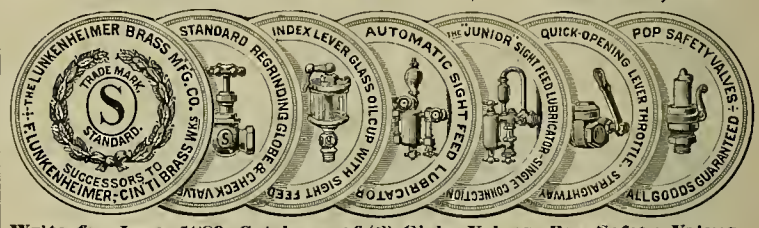

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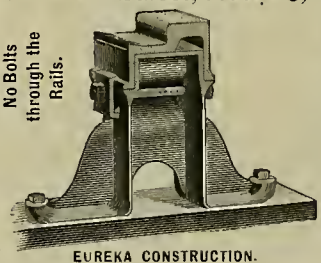

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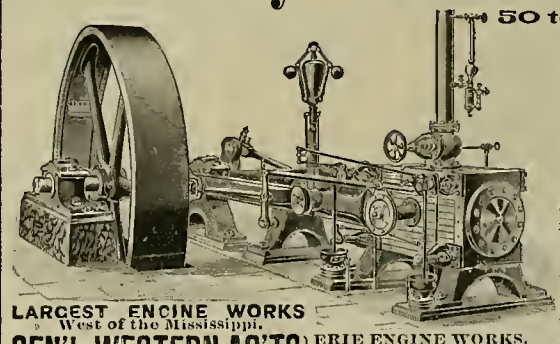

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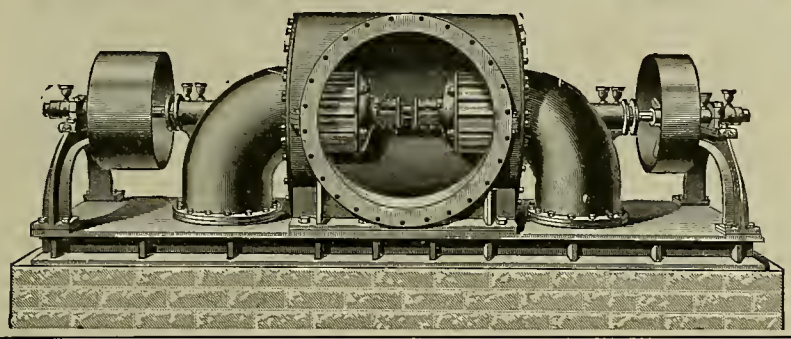

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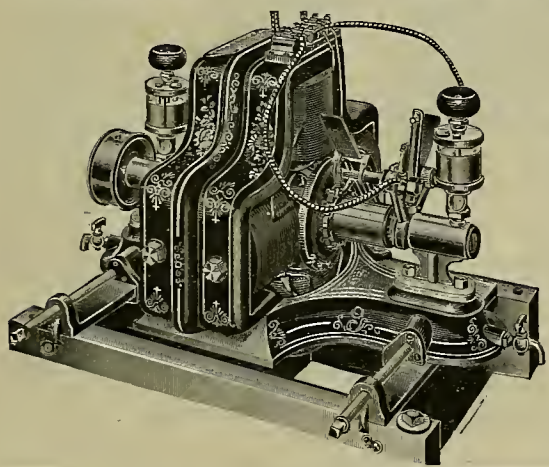

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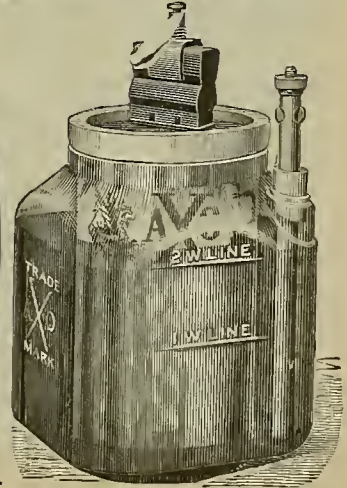

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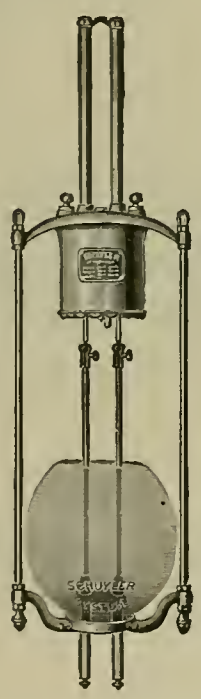

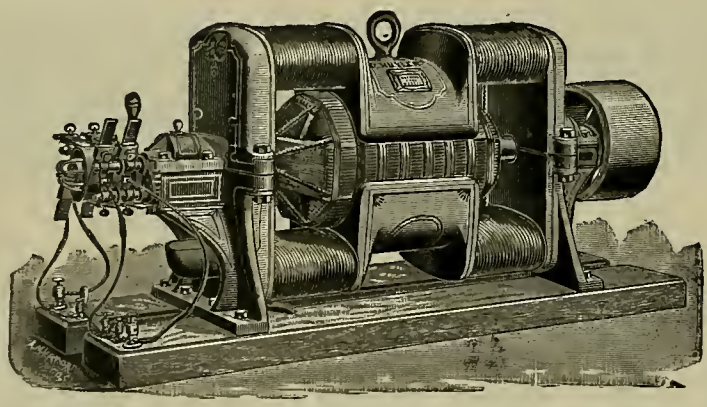

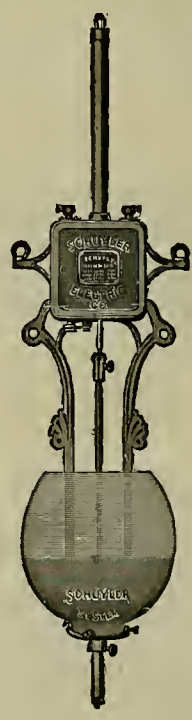

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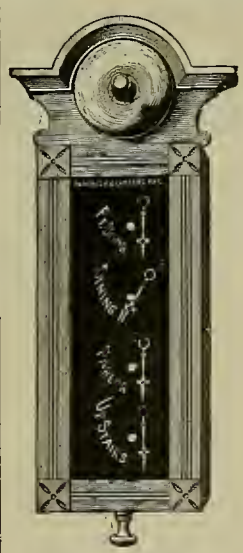

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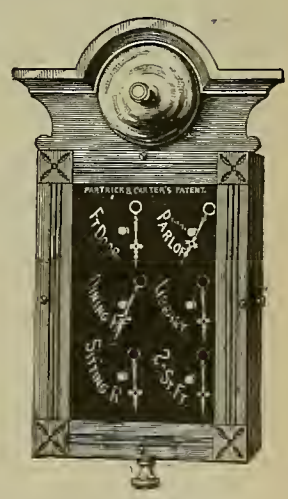

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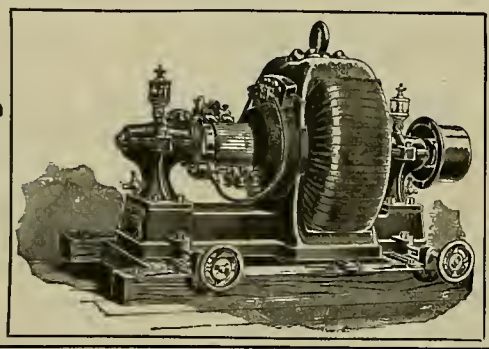

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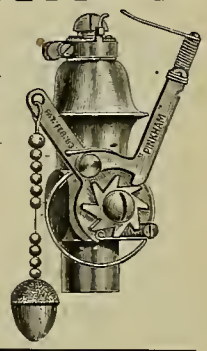

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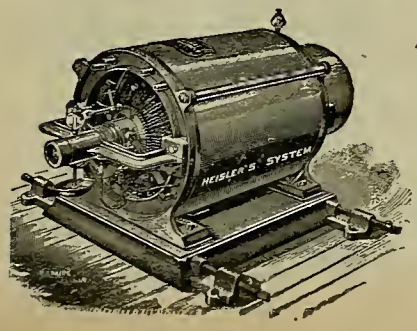

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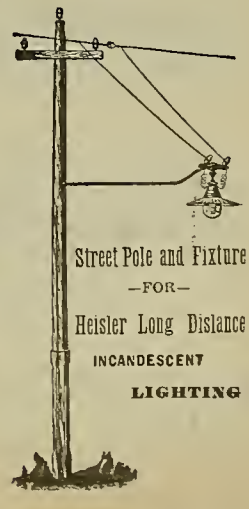

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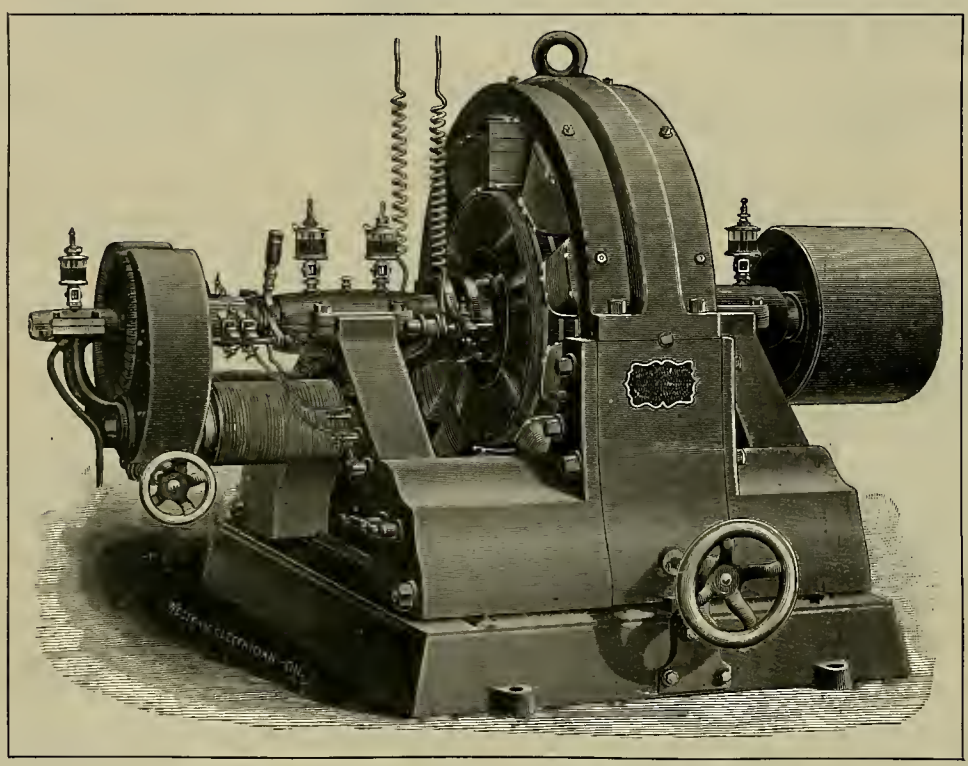

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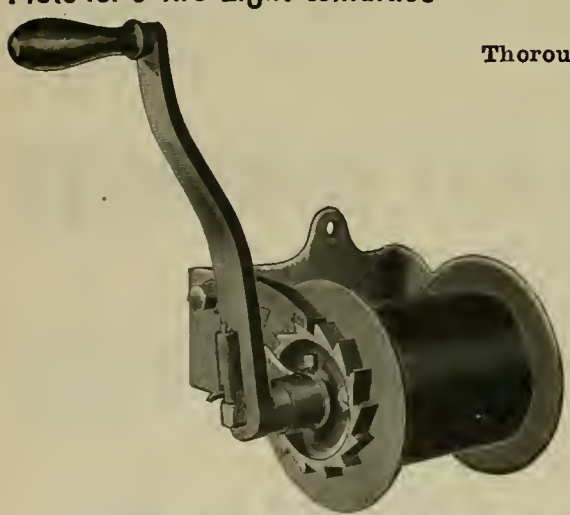

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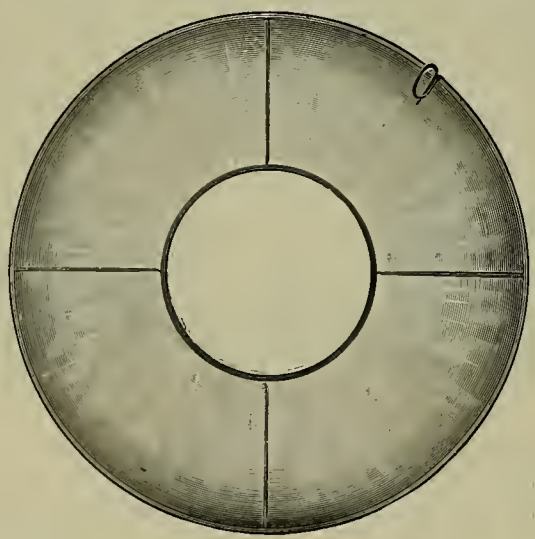

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BRUSH PATENT SUSTAINED.

The broad right to the use of Double Carbon Electric Arc Lamps declared to belong to the Brush Electric Company, under U. S. Letters Patent to Charles F. Brush, No. 219,208.

In the suit of The Brush Electric Company vs. The Fort Wayne Electric Light Company, decided at Indianapolis, Dec. 24, 1889,

JUDGE GRESHAM HOLDS:

1 *That Brush was the Pioneer Inventor in Commercial Arc Lighting.*

2 *That the Brush Patent in suit is the Pioneer Patent for Double Carbon Arc Lamps.*

3 *That the Patent is Broad and Fundamental.*

4 *That all its Claims (six in number) are valid.*

5 *That the claims of the Patent are all infringed by the Defendant.*

The Court says: "The separation of the two pair of Carbons, so that the Arc is established between one pair and maintained between the Carbons of that pair until they have been consumed and then automatically established between the Carbons of the other pair and maintained between them until they have been consumed is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the Lamp in suit from all prior lamps."

The Brush Electric Company is assured by the most competent legal advisers that under this Brush Patent, as interpreted by the U. S. Circuit Court, practically all Double Carbon Electric Arc Lamps now offered for sale are

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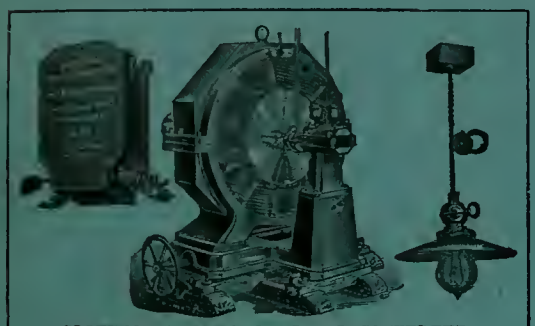

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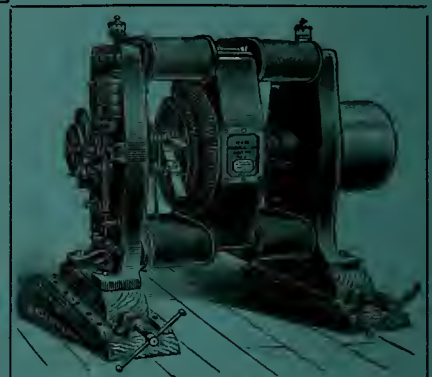

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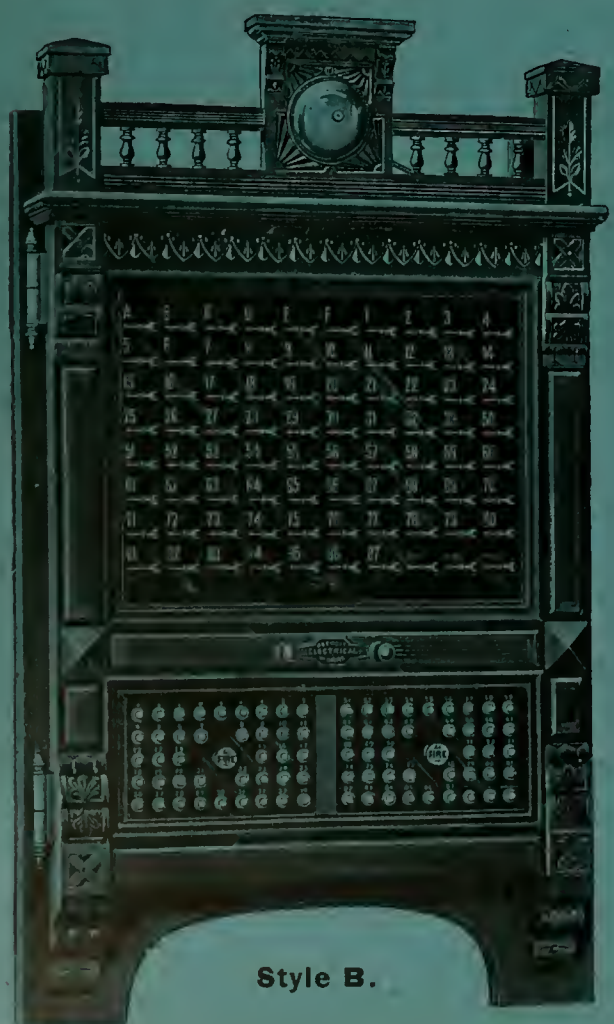

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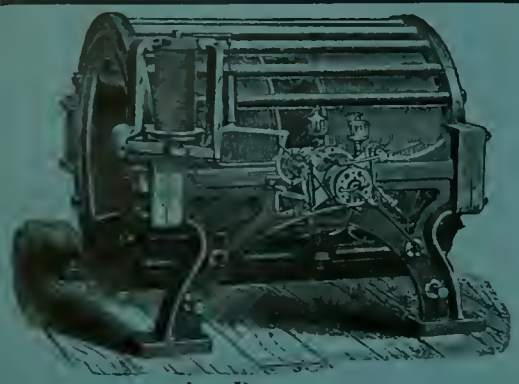

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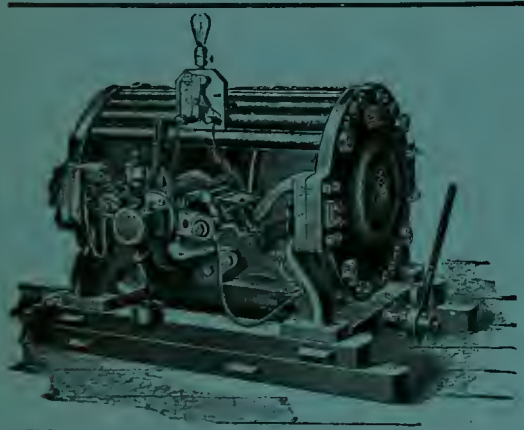
No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent., are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.



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Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.

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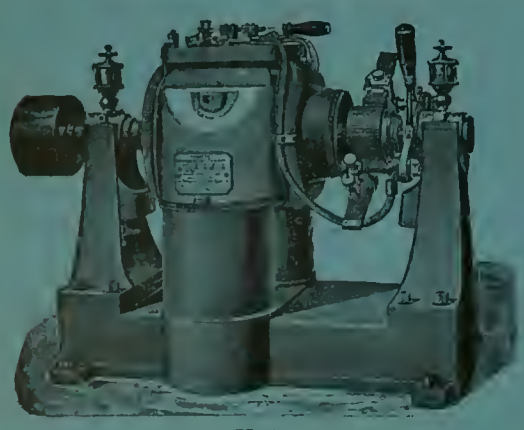

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The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

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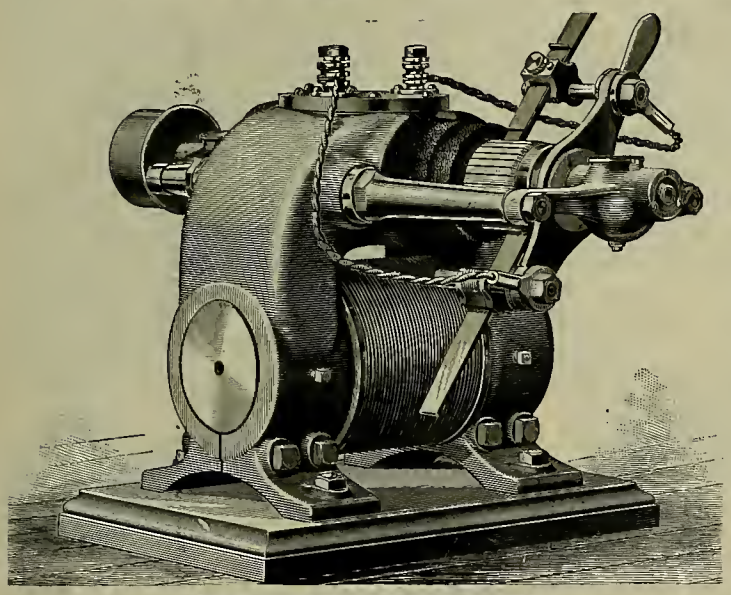

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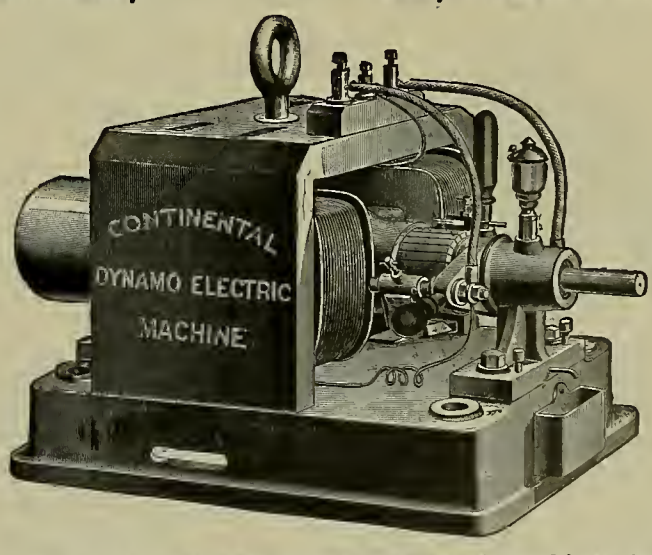

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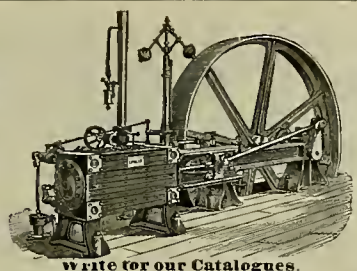

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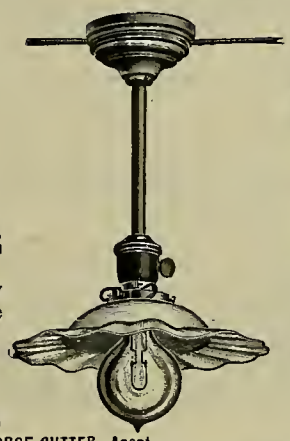

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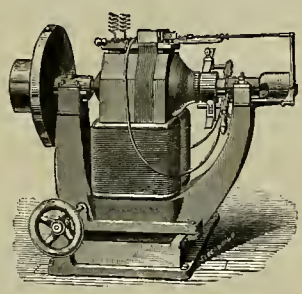

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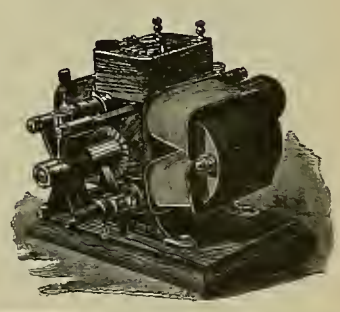

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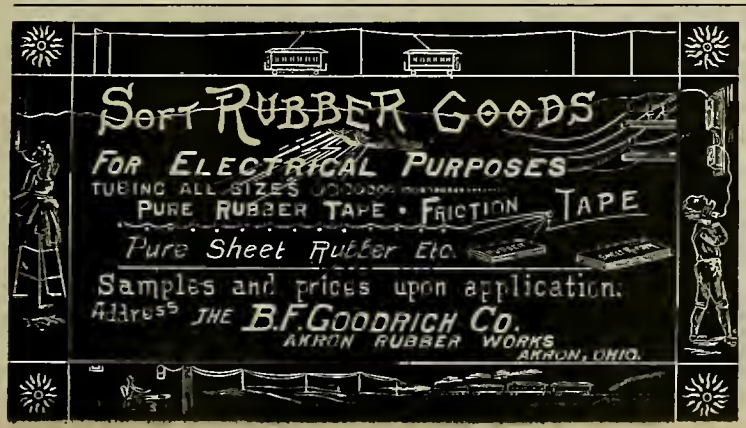

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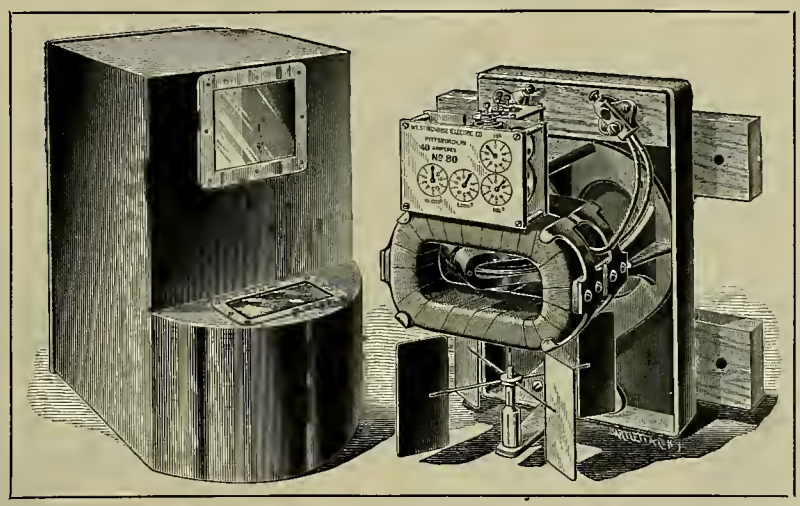

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Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, JANUARY 25, 1890. No. 4

Electric Light Plant in the New York Life Insurance Building, Kansas City, Mo.

One of the handsomest and most costly structures in Kansas City is that which has recently been erected by the New York Life Insurance company. This building is located at Ninth and Wall streets. It is ten stories high and contains 324 rooms without counting those in the basement and sub-basement. The electric light plant is located in the sub-basement. The accompanying cuts show the dynamo room and a special marble-faced switch-board from which the various circuits throughout the building are controlled. The steam plant consists of four Babcock & Wilcox boilers and two Watts-Campbell engines. The boilers have a capacity of 500 horse power, and the engines together furnish 350 horse power. These latter are belted to a main shaft which is in turn connected, as shown in the illustration, with the Brush dynamos. The plant supplies current to all the circuits in the building. The building is wired for 3,000 lights.

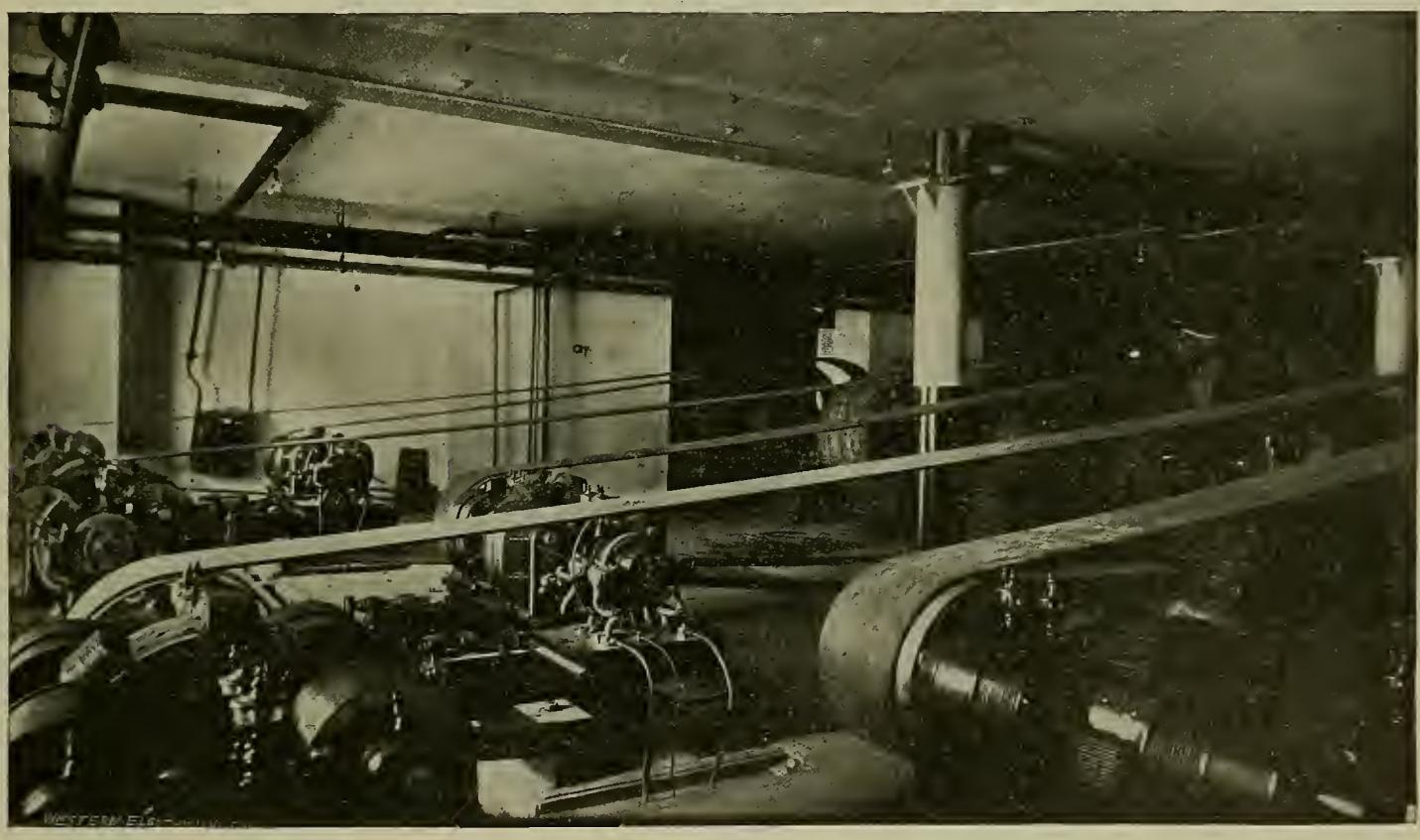

FIG. 1.—ELECTRIC LIGHT PLANT IN THE NEW YORK LIFE INSURANCE BUILDING AT KANSAS CITY, MO.

The dynamos are six in number and each has a capacity of 400 16-candle power lights. The machines are all compound wound to deliver current at a pressure of 100 volts and the armature of each is of the open coil type. One of the most interesting features about the plant is the arrangement of the circuits at the switch-board. In designing this plant the engineers aimed to avoid the necessity of running the machines in multiple arc. As the disadvantages of connecting compound wound constant potential machines in parallel are well understood, the ingenuity with which this problem was worked out will be appreciated. Referring to Fig. 2, it will be seen that the board is divided into as many sections as there are machines, *i. e.* six. Now the building is wired in six sections; in other words, there are six sets of feeders all of which terminate in regular order at the top of the board. The row of switches placed along the upper edge of the board indicates this arrangement. Each set of feeders is independent of the other—in fact, is a separate system. In order thoroughly to understand the manner in which the dynamos are connected in relation to the several circuits, it will be necessary to explain, somewhat in detail, the construction of the main switches. These are six in number—one for each system—and are shown prominently in the illustration just above the ammeters. The design of this special switch is somewhat peculiar. The contacts are constructed in a similar manner to those of the ordinary cleaver switch which is now so largely used. They are arranged about the center of the switch as shown in sets of four. The two inside contacts of each set connect respectively with the + and — "bus" bars belonging to that particular one-sixth of the system of feeders. The two outside contacts of each set connect respectively with the six dynamos. In other words, each of the six dynamos is represented by two contacts in each switch. A given set of feeders, however, connects only with its respective switch. Connection from contacts to contacts is made by two metal bars or strips, which are carried by the hand wheel as shown. The switch is operated by simply loosening with the thumb a small catch which holds the wheel down in place; pulling it out and moving it into the desired position and pushing it back again into place, where it is once more locked by the catch.

It will now be readily seen that to throw the machine marked "B" on to all of the six sets, assuming for illustration that the load is light but well distributed—it will only be necessary to quickly change the position of the five remaining switches. Assume, again, that it is desired to change the dynamo on a given set of feeders. It is evident then that only one movement is required. By this arrangement the machines are never run in parallel. The ammeters being connected with feeder "bus" bars indicate when it is necessary to throw on or off the different dynamos. The smaller switches, already referred to as being ranged along the top edge of the board, are of the pull or push type; the act of pulling opens the circuit and pushing closes it.

Electric Motor in a Printing Office.

The printing department of the John Morris Printing company, Chicago, was started up as usual Monday morning, Jan. 13th, despite the fact that the engine and boiler had been completely wrecked in the explosion of the previous Friday. The company found that it would be impossible to replace the engine and boiler within a month, and as this would cripple the concern and entail a loss through failure to fill contracts and necessitate shutting down the printing office, it was decided to look about for other means of securing power. The Thomson-Houston Electric company was appealed to and it immediately undertook the relief of the company. A 40-

horse power motor was installed, connection was made with the Edison circuit and within twenty-four hours everything was in readiness to begin work. The company was highly pleased with the arrangement as it was relieved from the necessity of closing its establishment pending the replacement of its steam plant.

Illinois State Electric Light Association.

A meeting of representatives of the central station electric lighting companies of Illinois was held at the Chicago Electric club's headquarters January 18th, for the purpose of forming a state organization. C. H. Wilmerding, superintendent of the Chicago Arc Light & Power company, presided, and Charles E. Gregory of the Sun Electric company, Chicago, acted as secretary. Allen R. Foote, chairman of the National Committee on State and Municipal Legislation of the National Electric Light association, stated the benefits to be derived from the proposed organization. He also outlined the course pursued by the several similar organizations that have already been formed.

It was decided to call the organization the Illinois Electric Lighting association, and a constitution was adopted. The objects of the organization are to promote, protect and harmonize the interests of the manufacturers of electricity for commercial purposes in the state, the securing of uniformity in regulations for inspection of construction and inside wiring, also of underwriters' rules for insurance, and to give such assistance and advice to the companies in its membership as may not be inconsistent with the general interests of the industry and to co-operate with the state associations already organized for the same objects.

Central station companies, firms and individuals engaged in Illinois in the manufacture of electricity for the commercial uses of light, power or heat are eligible for membership.

The annual election of officers will be held next May, and temporary officers were chosen at the first meeting to officiate until that time. The names of the officers chosen follow:

President, C. H. Wilmerding, Chicago; first vice-president, A. L. Ide, Springfield; second vice-president, Douglas Hapemen, Ottawa; secretary and treasurer, Charles E. Gregory, Chicago. Charles I. Page, Englewood, and M. B. Beal, Rockford, were chosen members of the executive committee.

Mr. Foote announced that this was the seventh state organization of the kind formed since last October, when the work was begun. It was hoped that much good would arise from the organization. Everywhere the plan of the organization had been received with favor, and much good was anticipated by the members.

Prof. Von Siemens' Opinion of the Dangers of Electric Lighting.

In a recent issue of the New York *World* appears a special cable dispatch giving the details of an interview with Prof. Werner Von Siemens on the use of electric light in Berlin the correspondent says: "All the theaters are lighted with it; in fact a law has just been passed compelling all theaters capable of seating eight hundred or more people to use electric lights. The palace of the emperor is now being fitted with electric lamps from cellar to garret. Danger to life or property is never for a moment considered."

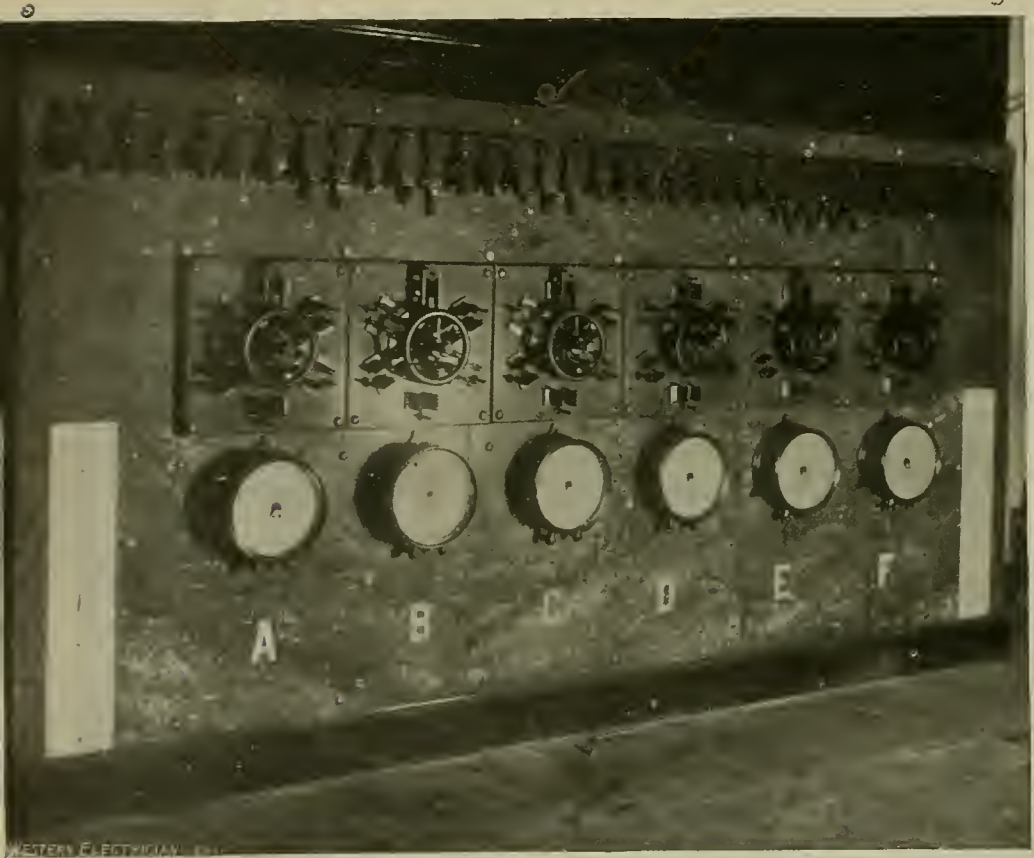

FIG. 2.—ELECTRIC LIGHT PLANT IN THE NEW YORK LIFE INSURANCE BUILDING AT KANSAS CITY.

Prof. Von Siemens was found at his home in Charlottenberg. When asked his opinion he said all dangers of electric lighting could be easily avoided. He continued: "By well constructed underground conduits the danger of electric light wires can be totally abolished if low pressure currents are used, and the dangers resulting from very high pressure can be reduced to a minimum in the same manner. There is no doubt at all that the greatest proportion of such accidents as have happened in New York will cease on the day when the last overhead wire is buried. Gas and water pipes," Herr von Siemens continued, "can never act as conductors of dangerous electric currents from the underground wires into dwelling houses. These pipes, if crossed by such a current, would at once divert it into the ground. It is just so with lightning rods, which electricians frequently connect with the water pipes because they make the easiest and most perfect distributors of electricity, diffusing the current over so wide an area as to make it harmless.

"The insulated wires for street lamps should be placed inside of hollow lamp-posts. For interior lighting (houses, stores, etc.) no high pressure currents should be used unless the construction is such that every possible danger from contact with conductors and lamps is obviated. Electric light conductors will never cause a fire unless they are carelessly constructed. A well planned and properly constructed conductor, supplied with the necessary safeguards, is entirely harmless. No death caused by contact with electric wires has ever happened here in Berlin. A few accidents by fire have happened in isolated plants, but always because of faulty construction. Overhead wires should never have more than 500 volts pressure. Underground conductors, with transformers, no more than 2,000 volts. The transformers and conductors should, however, be tested up to 5,000 volts. My system of insulated conductors, protected by lead cover, asphaltum and sheet iron, has proved successful wherever it has been used—in Berlin, Munich, Rome, Milan and other Continental cities. Some of these cables have been in use (partly for high pressure and transformers) for six years and are apparently good for a long time to come. Their exact duration cannot be fixed. Time only can solve that question. This system, or a similar one, will overcome all the difficulties you Americans have to contend with. In conclusion I will say that high pressure should never be used, except where for pecuniary or technical reasons, it is impossible to introduce low pressure."

Electric Light in the Windsor Theater, Chicago.

Chicago theaters have attained considerable distinction through the superiority of their illumination. Every theater of any consequence in the city is lighted by electricity and in many instances the houses are provided with their own plants. The Chicago Edison company which has made a specialty of this class of work, has brought theater lighting to a great state of perfection. It has just added another to its list of installations of this kind. The Windsor theater on North Clark street, Chicago, which was burned recently, has been rebuilt and one of the new features of this attractive place of amusement is its electric light plant. It is one of the best lighted theaters in the city. The power plant is located in an excavation in the rear of the theater, and is entirely separated from the building. A 90-horse power Russell engine drives two compound Edison dynamos in multiple arc. The capacity of these machines is 900 lights. The lights are all controlled from the stage switch-board underneath which 8 fire proof resistance boxes are arranged.

In the main entrance to the house there are 61 lights and 75 are arranged about the portico. A ball cluster at the entrance, containing 14 lamps, forms an attractive feature. The auditorium and galleries are lighted by 210 lamps. This does not include the sun light which contains 50 lamps, or the proscenium arch in which there are 124. The boxes have 36 lights and 50 more are used to illuminate the painter's bridge and ground row.

The stage is brilliantly illuminated. There are 50 lamps in the foot row; and 120 in the borders. There are also 8 movable bunches or clusters of 6 lamps each. These are arranged on stands in front of reflectors, and can be placed in any position desired. Attached to each of these is a flexible conductor at the end of which is a brass plug. There are a number of "pockets" in the stage floor arranged at convenient distances in which these plugs are placed, thereby completing the circuit. These bunch lights are of great convenience in producing brilliant effects in stage setting. They are far superior to any other form of illumination for this class of work.

The management of the house is thoroughly satisfied with the operation of the plant, and has good reason to be proud of it.

The Rockford, Ill., Electric company finds the present capacity of its works scarcely sufficient to supply the demands for apparatus. It is therefore necessary to run nights as well as days. At present it is engaged in filling an order of fifty electric motors for Jones & Bros., Philadelphia. These motors will be used to operate spice and coffee mills and will be one-half horse-power each. An order for three 7½ horse-power and one five horse-power motor for Blomgren Bros., & Co., Chicago, has also been received by this company.

The Short Electric Railway System.

The accompanying cuts illustrate a few of the details of the Short electric railway system. There are also presented two views of the cars in operation at Ensign, W. Va., and at Cleveland, O.

Fig. 1 represents the general design of of the station switch-board. This is a most substantial piece of apparatus. It is made of highly polished oak or mahogany, nicely paneled and is set out from the wall to admit of easy adjustment of wires and connections from behind.

wires should the current increase so as to endanger the generators; controlling switches for the incandescent lamps used in the station; and ammeters and voltmeters for each machine, a glance at which will show the amount of power consumed on the line at any moment. Wires leading from the generators to the switch-board pass under the floor of the station. Those leading from the switch-board to the line pass out through the roof.

In connection with its system of electric traction, the Short Electric Railway company is exploiting a method of lighting its cars. There are placed in a car five incandescent lamps of 16-candle power each. The wires which connect with the lamps are concealed behind the woodwork of the ceiling as shown in Fig. 2, and each car has its own lamp switch. The current is carried from the motor to the trail cars by means of a flexible conducting cord, heavily covered with insulating material. The system of lighting extends to the power station, car sheds and city streets. The necessary current is taken from the wires at any convenient point. One of the electroliers, with three lamps, for the center of the car, is represented in the illustration. In Fig. 2, besides the lighting system, there is shown the general design of the switches which are used in connection with the power equipment. The small figure to the left in the cut represents the fuse boxes. These are introduced when the constant potential system is used. When an abnormal increase of current from any cause melts a fuse, another is immediately connected by removing a plug from one hole to the next. The time necessary to replace the melted fuse is thus saved, and with five fuses a series of accidents would still leave the car protected. This feature of the system will be appreciated by street car men.

FIG. 3—SHORT ELECTRIC RAILWAY SYSTEM—ROAD AT ENSIGN, W. VA.

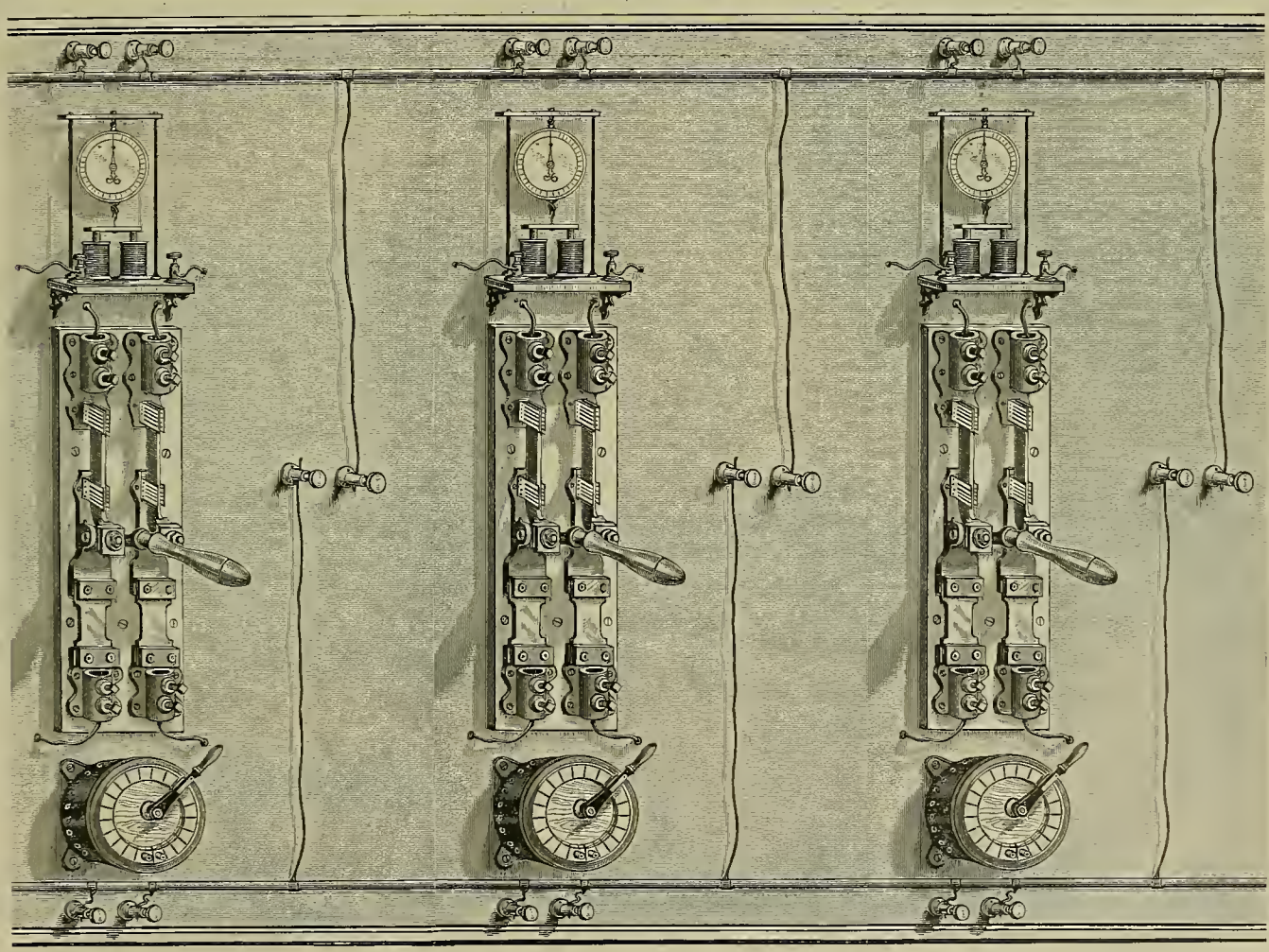

FIG. 1 —SHORT ELECTRIC RAILWAY SYSTEM—STATION SWITCH-BOARD.

The large "bus" bars arranged to receive the current from the generators, and all connectors, are highly polished and lacquered. On the board are all necessary switches for the main line and feed wires; lightning arresters with choking coils; fuses to act as safeguards to the generators; automatic cut-outs for the main

Special Train for the Kansas City Electric Light Convention.

It was stated in the last issue of the WESTERN ELECTRICIAN that the eastern delegates to the Kansas City convention of the National Electric Light association, would reach Chicago on the special train February 10th, and would be entertained by the Chicago Electric club at lunch. The board of managers of the club has appointed the following committee to arrange for the entertainment of the guests: W. A. Kreidler, chairman; F. E. Degenhardt, Alex. Kempt, F. G. Beach and F. B. Badt. The special train for Kansas City will leave Chicago at 5 P. M. February 10th. Application for sleeping car space in the special cars which are added at Chicago should be addressed to W. W. King, City Passenger and Ticket Agent, C. B. & Q. R. R., 211 Clark Street, Chicago.

Electric Light for China.

The introduction of electric lighting in China has marked an important epoch in the history of that country. The announcement that permission had been gained to introduce the new light, created considerable excitement in electrical circles and the accuracy of the report was questioned until it became apparent that such was really the case. A syndicate of wealthy Chinese merchants at San Francisco was formed for the purpose of introducing the light, and stock amounting to $500,000 was immediately disposed of. As soon as the company was formed representatives went to China and made arrangements with the government, to light the cities of the Canton province. The franchise which they secured is to run 50 years. They have since been devoting their attention to the study of the several systems in operation in this country. The first shipment was made a few weeks ago and another will follow shortly. The extent of this enterprise has not been fully realized in this country as the promoters though they have been engaged in the enterprise fully six months, have worked very quietly and did not reveal their plans until they had secured their franchise from the Chinese government.

The illumination of the public buildings and

FIG. 1.—SHORT ELECTRIC RAILWAY—ROAD AT CLEVELAND.

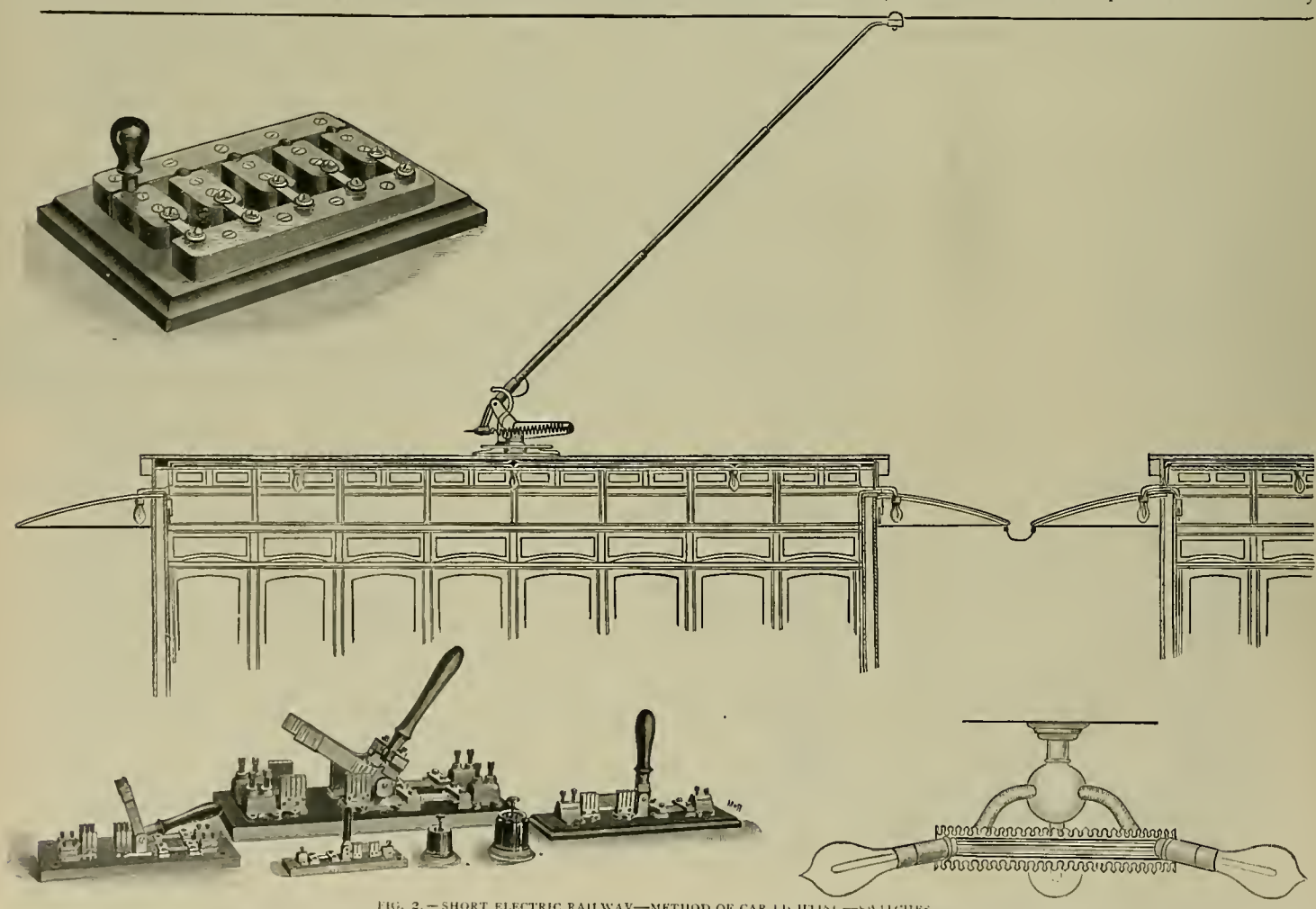

FIG. 2.—SHORT ELECTRIC RAILWAY—METHOD OF CAR LIGHTING—SWITCHES

offices of Canton will first occupy the attention of the company, and afterward street lighting will be attended to. At present gloomy little coal-oil lamps at long distances furnish the only light that can be found on the streets of Canton.

The Chinese have taken kindly to electric lighting. It has already obtained a footing and the highest praise is extended to it by the Chinese officials in Shanghai, where the electric light franchise is controlled by an English syndicate. The Canton officials, however, report a preference for American machinery and they also favor dealing with Americans. It is expected that as soon as the Canton province is supplied with electric light the company will extend its field of operations to other parts of the empire.

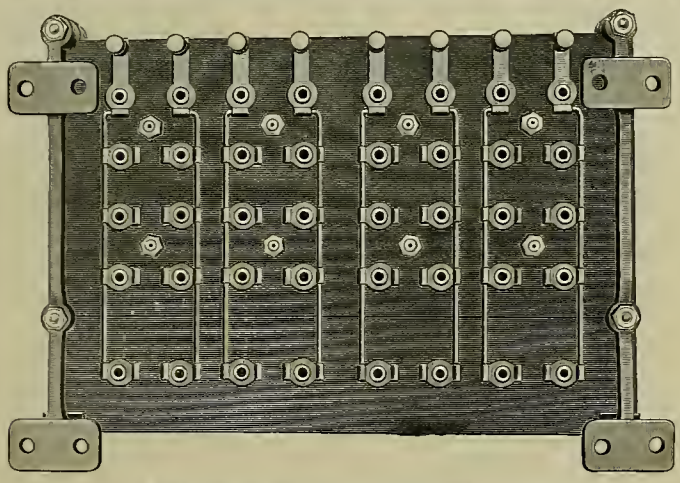

FIG. 2.—THOMSON-HOUSTON ARC LIGHT SWITCH-BOARD—REAR VIEW.

Thomson-Houston Arc Light Switch-Board.

Of all the appliances used in the operation of arc light machines none is of greater importance than a well-designed switch-board. There are few central lighting stations in which commercial and street lights are not operated, making it necessary for convenience and economy to place two or more circuits in series on one dynamo to transfer circuits from one machine to another, and to make such combinations of dynamos and circuits as local conditions render necessary. It is most desirable that there should be no extinguishment of the lights while these changes are being made, and that the construction of the board be such as to insure the operator against receiving a shock while so doing. The switch-board, illustrated in the accompanying cut, meets these requirements, as it is incombustible, and is of such construction that additions can be readily made without necessitating any changes in the part of the board having the circuits already in position. Fig. 1 is a front view, Fig. 2 a rear view, and Fig. 3 a side view. The board is made of two rectangular slate slabs, placed about five inches apart, into which are fitted rows of metal bushings. Those arranged horizontally on the front board are connected to the dynamos, while the vertical rows on the back are connected to each other and the circuits. On the back there is one more row of bushings than on the front; the extra row being used to connect one circuit with another by means of the transfer cables and plugs.

The switch-board is made for four and six circuits, and is so arranged that additions may be easily made by which the number of dynamos and circuits will be a multiple of four and six. The positive and negative terminals of the dynamos are connected to the left and right side respectively of the front board, and the circuits on the rear board in a like manner, the left being positive and the right negative, the bushings for the dynamos being numbered vertically 1, 2, 3, 4, while those for the circuits are numbered horizontally 1, 2, 3, 4. To connect a machine to a circuit the plugs are pushed through the holes on both positive and negative sides of the board corresponding to the dynamo and circuit desired. To connect any two circuits in series on one dynamo, before the machine is started the plugs are pushed through the holes corresponding to positive of one machine and one circuit, and then by means of the transfer cable and plugs at the bottom of the rear board the negative of this same circuit is connected with the positive of the second circuit which it is desired to place in series with the first, the final connection being made by pushing the plug through the hole corresponding to the negative of the second dynamo and negative of second circuit. To transfer circuits from one dynamo to another when the machines are in operation without disturbing the lights, as for instance, transferring circuit No. 1 from No. 1 to No. 2 dynamo, No. 1 dynamo is connected to No. 2 circuit by the plug, and No. 2 dynamo to No. 1 circuit. The circuit can then be broken between the dynamos and circuits No. 1 and No. 2, permitting No. 1 dynamo to be shut down, and the positive of circuit No. 2 connected to negative of circuit No. 1, by means of the transfer cables and plugs. The wall space required for a four-circuit board is 19x25 inches, and that for six-circuit board 24x35 inches.

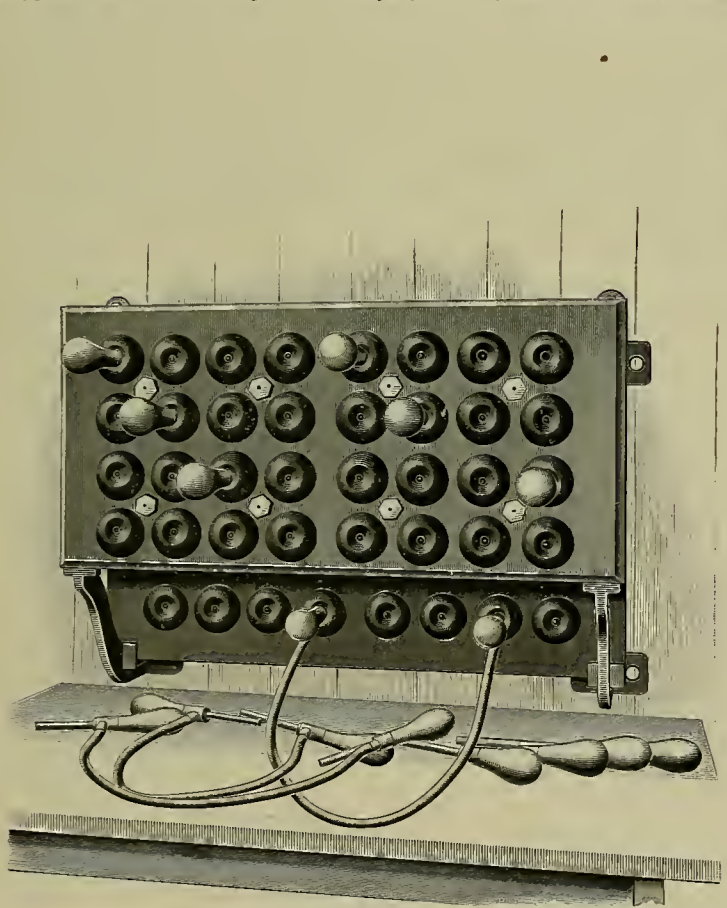

FIG. 1—FRONT VIEW.

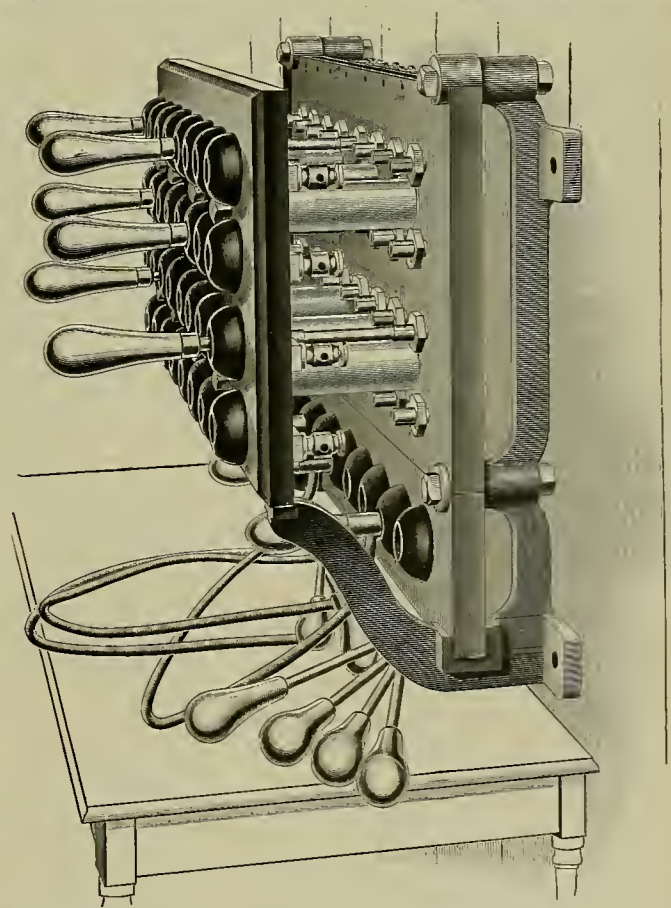

FIG. 3—SIDE VIEW.

THOMSON-HOUSTON ARC LIGHT SWITCH-BOARD.

Chicago Electric Club.

In the absence of President Beach who was unavoidably detained out of town, F. B. Badt presided at the meeting of the Chicago Electric club, last Monday evening. The treasurer reported a balance of $180.93 in the treasury.

The secretary reported that the eastern delegates had accepted the invitation of the club, and would be entertained at the club rooms Monday, February 10th, before proceeding to Kansas City to attend the convention of the National Electric Light association. Foree Bain read an interesting paper which is presented elsewhere in this issue, and was tendered a vote of thanks by the club.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 135 TEMPLE COURT, NEW YORK.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

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AT the last meeting of the Chicago Electric Club, Foree Bain read a paper on "Experience as a Teacher in Electrical Engineering." The article is presented elsewhere in this issue. It merits a careful perusal, as it is full of practical suggestions.

MANUFACTURERS who use mica insulation will be interested to learn that the ways and means committee of the House of Representatives has been asked to recommend the protection of mica. The producers think that a tariff of about $2,000 per ton would perhaps be sufficient. Fortunately the stove men of the country may be depended upon to oppose the adoption of such a measure.

GOVERNOR CAMPBELL of Ohio devoted a few lines to the subject of electricity in his inaugural address. This portion of his speech we reproduce, not because we agree with what the governor says, but simply as a matter of news. The extract is as follows: "The application of electricity is rapidly opening new fields of legislation. Unless something be done to prevent the sacrifice of life daily resulting from defective electric wires, the companies which put up and control them will have grown so rich and powerful that the passage and enforcement of proper laws will be difficult. Municipalities have attempted to enforce regulations for protection from such dangers, but without satisfactory result. The duty of investigating the generation and distribution of electrical currents is one which presses upon you. The investigation should be prompt and thorough; the result thereof made public; and such action taken as may in your judgment throttle this evil in its infancy." The statements which the governor makes are not borne out by the facts, we think; neither do we consider that this matter of legislating on the subject of electric wires is presented in the proper spirit.

CINCINNATI, O., seems to have a city council with fair-minded business men in it. At a recent meeting, when the subject of underground wires was considered, the council agreed that it would be well to wait six months or a year before taking steps toward requiring the electric companies to go underground. At that time it is hoped the city will be able to take advantage of the experience of other cities, and build its own subways. The council has retained the services of an expert to look into the matter and consult with the local companies.

THE committee appointed by the National Electric Light association to memorialize congress to abolish the copper tariff has just taken an important step. George M. Phelps of New York, representing the committee, appeared before the House of Representatives' Committee on Ways and Means last week, and presented the arguments in favor of the abolishment of the duty. The United States not only produces, he said, more copper than it consumes, and therefore exports it, but it possesses the richest and most easily worked mines in the world. American copper mine owners produce copper, and can put it on the market at lower cost than the Spaniards or Chilians, and consequently no duty is needed. The duty is of no value to the treasury, and is not needed for protection, because it is not imported in any considerable quantities, while considerable is exported. It is to be hoped that the committee will earnestly consider the matter. No valid argument, it seems to us, can be framed for the continuance of the duty. Major McKinley, the chairman of the committee, is an ardent protectionist, but several influential papers in Ohio, which support him most enthusiastically, have recently printed strong editorials in favor of the removal of the copper tariff.

EXPLOSIONS in the subways in New York city are becoming rather frequent. The gas companies are not compelled to maintain their mains in any sort of repair, and until some action is taken to force them to prevent leakage a continuance of these explosions may be expected. A New York paper, in commenting on the frequency of these explosions, says: "If the gas mains were properly constructed the gas could not escape from them. They are not properly constructed, and the gas companies should be compelled to place and keep them in order. It is an axiom that he who maintains any structure for his own profit must be at the charge of making it safe. There may be faults also in the construction of the subways. They ought apparently to be gas-tight, and they are not so. For that the Subway Construction company is responsible. But the primary source of danger is in the dilapidated condition of the gas mains, and that has long been a source of injury to the public health. Gas is so cheap a product that the companies prefer—as one of their officers has admitted—to suffer the loss incident to leakage rather than spend the money necessary to keep the mains tight. Our soil is saturated with gas and the atmosphere poisoned with it. Now that the danger of explosion is added, it is time for some systematic effort to be made to compel the gas companies to put their pipes in proper condition." In view of the fact that so many companies are now considering the problem of burying their wires, the escape of gas from defective mains in the streets of all large cities assumes great importance. New York should lead in the matter, and force the gas companies to take some action in the premises.

Here is a note from an English electrical paper, which is interesting in this connection: "We recommend electrical engineers to consider this question seriously, for while it is quite possible that leakage from their conductors may cause explosions, it must not be lost sight of that coal gas has no right in their conduits, and that its presence, especially in wet or damp situations, is very deleterious to many otherwise good insulating materials, and may cause such injury that, beyond and quite apart from the risk of explosions, it will ultimately render necessary the replacement of cables which have, by its presence, become too seriously lowered in insulating qualities."

THE New York papers have been pouring hot shot into the Board of Electrical Control for the last week, and it seems to be the general belief that the legislature will take some decided action in regard to the board. Speaker Husted of the State assembly has appointed a committee on electricity, gas and water supply. The appointments on the committee constitute a new grievance. It is contended that the committee's work will have reference almost entirely to New York affairs, yet no New York city assemblyman was appointed. The correspondents think that the committee will recommend that the Board of Electrical Control be discontinued, and that the control of electric wires be vested in a new commission of some kind. Politics have more to do with the matter than they should. The majority in the assembly want to adjust matters so that the present administration in New York city shall have no influence with the new commission.

A bill was introduced in the New York Senate last week to abolish the present Board of Electrical Control of New York and substitute a State Board of Electrical Commissioners. The board is to consist of one Republican, one Democrat and one electrical expert. It is the design of Senator Roesch, who introduced the bill, to create a non-partisan electrical commission. If the expert appointed is a Democrat the clerk of the commission must be a Republican. The board is thus kept equally balanced politically. The members of the commission are to receive salaries of $4,000 each, and their clerk is to have $6,000.

IN the last issue of the WESTERN ELECTRICIAN it was stated that Chicago was to have overhead wires. This assertion was based on the fact that Commissioner Purdy had granted the Lake View Electric Light company a permit to run a pole line through the streets of that part of Chicago which was a city by itself, before the annexation of last spring. Just previous to the annexation of Lake View, its council granted an ordinance to the electric light company, allowing it to carry wires on poles for five years. Two years' additional time was also allowed, during which the conductors were to be put underground. When the Chicago commissioner was called upon to issue a permit for the commencement of the work of stringing overhead wires, he hesitated about granting it, inasmuch as it has been the settled policy of Chicago to refuse permission for the construction of aerial circuits. He consulted the law department and found that the ordinance was operative as the Supreme court had decided that all the ordinances granted by municipalities prior to annexation were to be recognized as valid by the present city after annexation. This Lake View ordinance, it was held, came under this decision. As other companies possess similar franchises in Hyde Park and the Town of Lake, which were also annexed, the decision is exciting considerable interest. There are two sides to the controversy. It is said, on the one hand, that it would work a great injustice if companies granted franchises by suburban towns before the annexation should suddenly be deprived of all their rights by arbitrary action by Chicago authorities. It is urged that annexation should not cut off privileges obtained at a time when the city authorities had no jurisdiction. On the other side, it is urged that it would be unjust to allow new companies to use overhead wires within the present city limits where no such privilege is accorded to the old Chicago companies. Prof. Barrett is of the opinion that the city has police powers that can be exercised to compel a general compliance with the underground regulations of the city. He is decidedly opposed to overhead wires anywhere within the corporation limits, and it is said he will soon present a communication to the city council asking the aldermen to take action in the premises.

Experience as a Teacher in Electrical Engineering.[1]

By Foree Bain.

"A thousand volumes in a thousand tongues, enshrine the lesson of experience; yet a man shall read them all and go forth none the wiser." The experience of a man may be considered as a book of which each day forms a page and the finale of life completes the volume. It is a book that cannot be truly translated into any language sufficiently expressive to impart to the reader the full text, force and meaning of its contents.

The five known senses which man possesses appeal to his reasoning faculties. In the operation of gleaning information from a book, the sense of seeing only is called into use, while the experience of many persons has con-

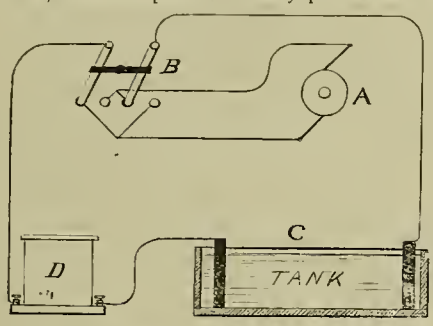


FIG. 1.—EXPERIENCE AS A TEACHER IN ELECTRICAL ENGINEERING.

tributed to the accumulation of the knowledge, enunciations of the problems, and to the expression of the thoughts contained therein.

Our environments are so crowded with mysteries, that it is hardly safe to say that we can express a thought that will convey the exact meaning intended. The capacity, the experience and the conditions of the individual must be considered; the impressions vary as the conditions of the individual vary. At one time the meaning will be as clear as the dawn of a summer morn, while at another time words seems expressionless.

There goes with experience an impression of reality unattainable by other means, the demonstration of a thought satisfies the mind that the thing is not only a logical conclusion, but an objective entity. It is suggested by some that the mind of man is gradually approaching such a degree of perfection that eventually all facts may be arrived at by a system of logical reasoning, and indeed some of the ancient philosophers believed that they could solve all of the problems in the universe by thought alone, but the modern philosopher realizes that meditation is futile unless accompanied by observation and experiment; in fact the rise in modern science is due to the adoption of the principle that the discovery of a physical truth consists, not in the mere logical statement, but in its experimental establishment. The discoverer of a truth is not he who guesses, though he may guess aright, but he who practically demonstrates a new fact, and thus compels its acceptance within the body of knowledge. Theories can be made to fit facts, but facts are inflexible. Facts form the wall around the fortress of knowledge, against which the arrows of theories and false conclusions fall harmless. There may be several theories to explain a single fact, but the fact remains unattained The fact is the exponent of the discoverer's thought, the index to the operation of his mind. By observing known phenomena he has been able to extract practically from nature new phenomena; hypothetical reasonings upon which a theory leading up to that result may be formed, are themselves valuable and instructive, but the practical demonstration is the true and greatest value of the investigation.

A book impresses the mind like the portrait of a friend; the finished picture is before you, the outlines of a reality

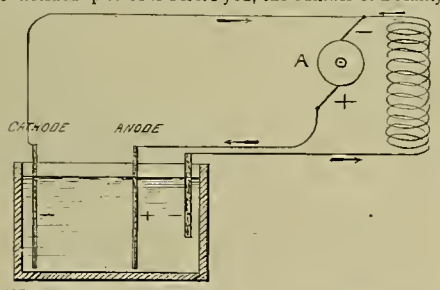


FIG. 2.—EXPERIENCE AS A TEACHER IN ELECTRICAL ENGINEERING.

are spread upon the canvas, every feature has been faithfully portrayed, the visage of the friend is recognized at a glance, the artist's work is complete; but you can not follow the various processes of nature nor the surroundings which have gradually developed the characteristic features of his subject; he can only present a picture of the work that has been previously done.

Books are the pictures of many minds, and like friends in need, they are friends indeed. While they can not impart to us all that is necessary to enable us fully to comprehend and understand some of the complex problems of life, they are as faithful guide boards in the path of knowledge, and point toward the direction of progress and success, without which we would wander unceasingly in the wilderness of mystery and ignorance.

The progress due to the activity of investigation and invention in the science of electricity and magnetism, within the last few years has fostered, encouraged and developed the need of a new profession in the field of industrial pursuits. The electrical engineer of to-day finds himself as firmly established, and the demand for his services, by the public, to be as enduring and of as high a character as that of the civil or mechanical engineer. What the future may have in store for him is not within the province of this paper.

I shall endeavor to address myself to the young men who are young in the study of electrical engineering, and furnish a few practical illustrations which may be a means of impressing upon them the necessity of an individuality in method, and read a few leaves torn from the book of experience, of an electrical engineer. We find that certain things must be done which are unusual; we search our text books, we can not find a precedent, they are one and all silent on this particular subject, or if they mention it at all it is in such a vague and indifferent way that the information, such as it is, is of little value.

The first illustration of my method of solving some such problems is shown by Fig. 1 and it has proven very satisfactory. The arrangement shows a method of measuring the difference of potential between the terminals of a generator of high e. m. f. This can be done using only a small ammeter, and without the use of a voltmeter of any kind, and the results will be almost perfectly correct, near enough at least for all practical purposes. *A* is a dynamo, + and — terminals, *B* a double pole switch, *C* a tank of pure water, *D* an ammeter reading from 1 to 10 amperes.

The tub is connected in circuit as shown, with two carbon electrodes, the resistance between the electrodes is measured in the usual manner before the current from the dynamo is passed through. Suppose that we know beforehand the approximate e. m. f. of the dynamo—say 3,000 volts—then, if our tub and circuit measure 1,500 ohms, two amperes will be indicated by the ammeter, C x R=E. The double pole switch is intended for two purposes: first, the reading should be taken as soon as the ammeter comes to a rest, and when it reaches the highest point, the circuit should be reversed by means of the switch, and the readings taken again when the ammeter reaches the highest point; the second reading is only necessary as a check on the first. The object is to eliminate any error that might result from electrolytic or osmotic effect. The switch also makes it possible to cut the entire apparatus immediately from the live circuit as soon as the readings are taken. By using a hot wire ammeter the method can be used for alternating currents, in which case it will not be necessary to use a switch to reverse the poles.

Fig. 2 represents what I have found to be the most convenient and most easily adjustable method for connecting a plating or electrotyping dynamo and tank. The e. m. f. necessary in this work is very low, and the current strength is great, so that when an ordinary wire rheostat in the field circuit is used for varying the e. m. f. as usual, the steps for adjustment are too great, rendering it impossible to obtain the exact e. m. f. desired. As the contacts heat, the current going through the field quickly and greatly decreases, causing the voltage to fall rapidly. Moving the arm of the resistance box to the next segment while it would temporarily correct the trouble, would finally intensify it by the increased heat of the contacts. Often the variation of one volt, or a fraction of a volt, from that required in galvanoplastic manipulation will so seriously interfere with the process of deposition as to cause entire failure. If the e. m. f. be too great the deposits will be granular and rough or burned; if too low the deposits will be slow and uneven. All modern dynamos designed for deposition are shunt or compound wound; the latter are liable to reverse, and the former are not always successful for the reasons just related.

The cut shows an ordinary shunt dynamo, the + brush connected to the anodes and the — brush connected to the cathodes in the usual way. One terminal of the field is connected to the — brush; the remaining terminal is connected to a small adjustable cathode, in the same tank. This small cathode may be placed near any of the anodes and may be so arranged that it can be conveniently moved toward or from the anode elements, thus decreasing or increasing the resistance of the field circuit. It will be understood at once that by varying this distance the ampere-turns of the field are consequently raised and lowered, and thus the e. m. f. may be minutely and permanently adjusted. All contacts may be soldered, and the resistance will remain practically constant

A very successful method of charging accumulators or storage batteries is shown in Fig. 3. Without mentioning the objections to the use of series and shunt wound dynamos, I will describe this method in forming and afterward charging accumulators. The thing desired is a process by which a maximum current will flow at the beginning of the charge, or forming process, and will automatically and gradually decrease in strength as the process proceeds, until a point is reached when the current must be discontinued altogether. It is a matter of great convenience if this process can be accomplished automatically, as the work would be far better performed than if an ignorant and careless attendant was in charge. In this case the dynamo must be especially constructed for the purpose. Suppose for illustration we desire to charge 300 accumulators, arranged, as shown, to 2.10 volts each. Our dynamo must have a difference of potential of a little over 105 volts at the terminals, or the potential necessary to charge, say 50 accumulators in series. Connect the accumulators in the first place in two groups, 50 in series in branch *A*, and as many in multiple to this group as desired, as shown, and connect a lesser number in branch *B*, say 52 or less and connect the two groups thus formed in series, one group being electrically opposed to the other. At the point where the two terminals are joined connect the — terminal of the dynamo through an automatic circuit breaker having an adjustable retractile spring or weight. Connect the + terminal of one group to the + terminal of the dynamo The + terminals of the other group must be connected to the + terminal of the dynamo through the field, and preferably a water and acid adjustable rheostat. Now adjust the rheostat so that no current will flow in either branch and start your dynamo. Close the circuit at the cut-out, and the dynamo current should divide through the two circuits in the direction as shown by the arrows. The current will gradually decrease as the e. m. f of the battery increases, and when the batteries have been charged to the desired point the cut out will disconnect the — terminal of the dynamo, and, as the batteries are balanced, no current will flow through the circuit Several series of batteries may be connected in parallel with the batteries in branch *A*, limited only by the capacity of the dynamo. The current of the dynamo will be always proportional to the sum of the resistance and counter-electromotive force of the groups. By this method a defective cell will be quickly detected by the diversion of current in the two branches.

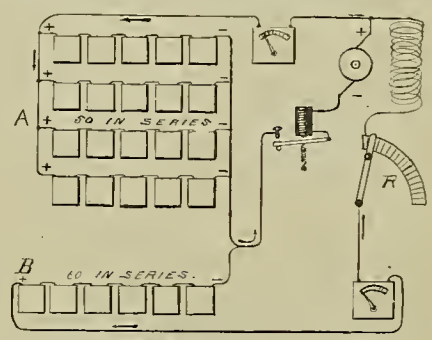


FIG. 3.—EXPERIENCE AS A TEACHER IN ELECTRICAL ENGINEERING.

In the spring of 1878 or 1879 I put up a telephone line for a gentleman in a little town in Ohio between his residence and a large sawmill about five miles down the river. A telephone was a question of doubt at that time, and naturally the event was anticipated with considerable curiosity and pleasure by all of the town folks. The line was completed and the instrument was properly connected at the residence, a number of people assembled to hear the "machine talk." In company with a boy who could make a noise with a mouth organ I set out with the other set of instruments for the mill. I got them connected all right and awaited a reply to my lusty "Hello! All was silent I soon discovered that the diaphragm of my receiver was missing. What could I do? To return to the town without demonstrating the success of the apparatus, that night, would have been as disgusting to the eager and expectant persons as to myself. A sawmill is a desolate place, and the only thing that I could find in the shape of a diaphragm was a circular saw and it was a trifle too large. I found a piece of writing paper, cut two diaphragms of this, got an old file and managed to file some bits from the head of a nail, placed these iron filings between the two paper diaphragms, removed the cap of the receiver and placed them in position, when, presto, my instrument worked to perfection. I merely mention this to show that many problems may be easily solved by the application of a few moments of independent and original thought. The text-books do not mention the use of a paper diaphragm, to be substituted in cases of this kind, for one "capable of magnetic induction" to use a familiar quotation. No particular ability is shown by this substitution for the usual form of diaphragm, for surely it was simple enough. My object in mentioning the instance was to illustrate the fact that experience naturally leads us in paths of practical expedients, and there will be many times when we may come in on "three wheels" so to speak, if first, we understand our subject well, and second, if we are not afraid to think of it in our own way and apply such remedies as will be suggested by mature thought and reflection.

It may be interesting to illustrate a few more problems which have been solved in a practical way. Fig. 4 shows how a repaired armature may be tested. I frequently have armatures only to repair. Sometimes one or more

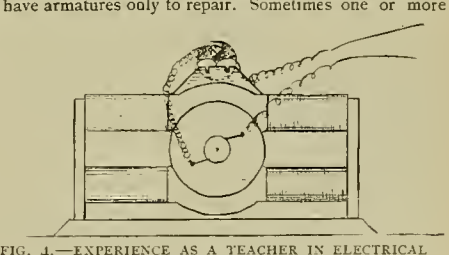


FIG. 4.—EXPERIENCE AS A TEACHER IN ELECTRICAL ENGINEERING.

new coils are to be wound in. It is necessary to make a test to see that there are no short circuits. The insulation resistance between the coils may measure up to the required standard and there may be no "grounds" on the core, but the only way a test can be made for short circuits is by actually running the armature as a motor or generator. Mount the armature between centers or on frictionless bearings and move it up by the side of the energized field of a dynamo and pass a current from the dynamo or other source through the armature. The armature will begin to revolve immediately. It will require only a few moments to discover a short-circuited coil if one exists, by the overheating of such coil or coils. It may then be corrected and tried again. When an armature has stood this test I am ready to guarantee it. Did you ever know a short circuit or burn-out to occur in a Siemens armature except in the lower coils? One would think that when this is so it

[1]Read before the Chicago Electric Club January 20, 1889.

would be necessary to entirely rewind it, but such is not the case; take the bands off and with a sharp chisel cut the injured coils in two and pull the ends out, fill up the space on the ends of the armatures where the old coil came out with shellac and cotton and wind new coils on the outside, connect up and test, and there you are. I have repaired armatures in this way that have run for years afterward.

Several years ago, I think it was when the first towers were being used from which to suspend arc lamps, I was consulted by the superintendent of such a plant who complained that the carbons of his lamps would not remain in line during the day. The wind would jar them so that they would slip by each other. When the dynamo was started at night they of course would not light up, but those that did light were not affected by the wind while they were in operation. This little problem was solved in the most satisfactory manner. I made several paper cylinders about 1½ inches long and a little tapering, and

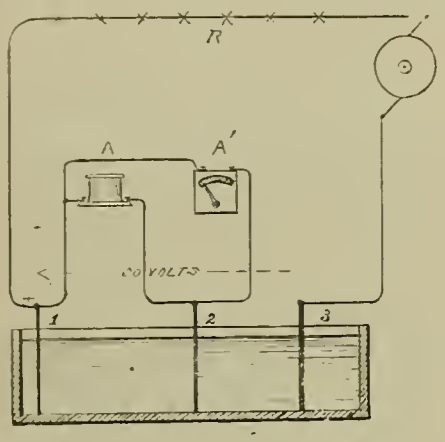


FIG. 5.—EXPERIENCE AS A TEACHER IN ELECTRICAL ENGINEERING.

placed them between the upper and lower carbons on the lamps, fitting them tightly on the upper carbon but loosely on the lower one. These paper stalls were put on the carbons by the trimmer, in the morning, and they would hold the carbons in place against the strongest wind. When the lamps were started in the evening the paper stalls would immediately burn off and the lamp mechanism would then hold the carbons in place. These stalls or cylinders were made of any kind of thin paper, by the trimmer or engineer at night, and did not cost anything but time to make them.

In 1867 while a telegrapher in a little country town, it occurred to me that I could make a self closing telegraph key, that would cause my name to go rumbling down the corridors of fame for an indefinite period. I conceived the idea of a pedal attachment to the key, so arranged that a slight pressure of the foot would open the circuit and a counteracting spring would close it. The idea was well worked out, and I was getting ready to spring it on an unsuspecting public when unfortunately my favorite dog sprung it for me. The space under the table was a favorite resort of his, especially when he became sleepy. One day when I was engaged elsewhere he laid down for several hours on my pedal attachment, and kept the line open. The superintendent "located" him, and of course the result was heartrending; in this case experience proved to be a teacher, for I have not made another pedal attachment since then.

Fig. 5 shows a very convenient arrangement for comparing voltmeters, or means by which a voltmeter or ammeter may be calibrated by comparison with one known to be correct. In this case a constant current dynamo, say 10 amperes, is shown. Several lamps

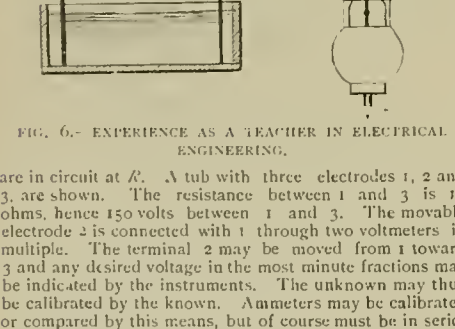


FIG. 6.- EXPERIENCE AS A TEACHER IN ELECTRICAL ENGINEERING.

are in circuit at *R*. A tub with three electrodes 1, 2 and 3, are shown. The resistance between 1 and 3 is 15 ohms, hence 150 volts between 1 and 3. The movable electrode 2 is connected with 1 through two voltmeters in multiple. The terminal 2 may be moved from 1 toward 3 and any desired voltage in the most minute fractions may be indicated by the instruments. The unknown may thus be calibrated by the known. Ammeters may be calibrated or compared by this means, but of course must be in series instead of multiple with each other.

Fig 6 shows a similar device for operating an arc lamp on an incandescent circuit. Any good arc lamp may be placed in a circuit of 110 volts by placing a tub of water and acid in series with it; the electrodes should be carbon and the evaporation should be looked after.

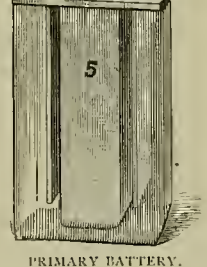
There are no practical units of magnetism and consequently there are no instruments to measure it directly. In the absence of such I have found that a very useful magnetometer may be devised, which will at least approximately show the relative strengths of electro or permanent magnets. An Ayrton & Perry voltmeter or ammeter, when placed in a magnetic field so that the lines of force are parallel with the length of its core will draw the core into the solenoid, the needle will indicate a certain number on the dial. Now place the instrument in a similar position in the field of another magnet and the deflection of the needle will be greater or less according to the comparative strength of the second magnet. This is very handy for quickly determining the fault of an unequal or distorted field in a dynamo or motor, and is close enough to enable you to repair such a fault and to learn when it has been corrected. I have seen "consequent pole" dynamos with a badly distorted field in which the distortion was caused by a greater number of ampere-turns on one limb of the magnet than on another, or by unequal magnetic permeability of the iron of which the field is composed, or an inequality of cross-section.

For fear that I may weary you with too long a paper I will close with a few words of advice to the young men who wish to succeed. The ladder of ambition is interminable in length, it extends upward from the densest ignorance of life and is shrouded with a mantle of mystery at the highest pinnacle of knowledge. There are a greater number at its base than have reached the giddy heights of success, there is more room as we ascend. If we have begun to climb, and our position makes it possible, we should not "look down" on those below. They may pass us some day and tread on our fingers. If we try to climb too many ladders we may find at the end of life that we have not reached a very high point on any of them and we will never get above the crowded position. Stick to one ladder and get as high on it as possible. The journey is a pleasant one if you will only contribute your share to the pleasure of others and be guided by the words of the immortal Pope:

"One science only will one genius fit,
So vast is art, so narrow human wit."

Primary Battery.

The cut presented herewith illustrates a new primary battery which has recently been placed on the market by J. H. Mason, Brooklyn, N. Y. The inventor claims for the cell great lasting qualities. The new zincs for the battery are prepared in such a way that they keep clean and bright. The fluid is of such a chemical nature it is claimed, that no crystals form and the current is maintained steady and just as strong at



PRIMARY BATTERY.

the last as at the first. It is further claimed that the action in this battery is such that the solution instead of the zinc is used up—in other words, that it is necessary to replenish the fluid more often than the zinc. As the cost of the fluid is less than that of the zinc, the inventor considers this a feature of importance.

High Tension Currents and Electrical Distribution Underground.

By H. B. Cobb.

So much has been said and written by great electricians about the progress of electricity, that the subject is now becoming a topic for general discussion. Daily newspapers are full of well written articles on the subject from engineers, electricians and scientists. Every branch of the subject has been considered but owing to the frequent accidents in New York from electric light wires, writers have of late confined themselves to a consideration of the dangers of electric lighting. They have argued and explained these dangers and pointed out what they consider to be the proper remedies.

I take it for granted that if it can be shown that the high tension current can be carried underground with perfect safety to life and property, no one will deny it in regard to low tension. Let us if possible, get at the facts.

Major Chas. W. Raymond, engineer, United States army, in a voluminous report to the United States Senate, on the subject of putting wires underground in Washington, says he sees "no reason why wires of all kinds cannot be placed underground," and states that in Europe the practicability of maintaining both the incandescent and arc lamps by underground conductors seems to be unquestioned.

Wm. E. Gray, of the India Rubber Gutta Percha & Telegraph company, of Silvertown, England, writes that a cable, seven to eight miles long, was laid in a three-inch iron pipe in Eastborn, England, in 1885, carrying 2,000 volts alternating current, and is still in successful operation. Of this cable, Mr. Gray writes, "We have tried many insulators but have come to the decided conclusion that up to this date no insulator has been found to equal vulcanized India rubber, if well mixed, of good quality of rubber, and put on under great pressure. Of such a cable it would be difficult to estimate its life." Mr. Gray also mentions the following cables of similar construction; at Silvertown, England, cable eight miles long, laid in 1883, carrying 2,400 volts, alternating current, still in good condition; in London cable two miles long, laid in 1887, carrying 2,400 volts with perfect satisfaction, still another in Brussels, five miles long, with like results. Encouraged by the success of these cables, Ferranti constructed and is operating a cable in London carrying 10,000 volts alternating current with great success, but owing to its great cost, probably it will never be generally adopted, especially in the United States.

Great as the success has been in Europe in this line, American manufacturers are obtaining far better results at very much lower cost. Several failures were reported in the attempt to carry high tension currents in this country in the early days of our experiments. Large cities had passed laws requiring wires to be placed underground by certain dates. "No time could be wasted or allowed for experiment, something must be produced at once to carry this great and powerful current." The inventor's mind was turned in this direction with such success that we are now able to carry underground an alternating current of almost any voltage. I will here mention a few cities where high tension currents are successfully carried underground. Prof. John P. Barrett, city electrician of Chicago, reports that the city has now nearly one hundred miles of streets lighted by electricity. All the circuits are underground and are working splendidly. There is no fear of accident and perfect safety to life and property is assured. He further says as an instance of the durability and reliability of underground wires, that those placed in conduits in 1887 are giving good satisfaction and are as perfect to-day as the day they were put down. He says, "We have never had occasion to touch them since; never had a cross or break on them and for aught I can see, will continue so." Washington, Buffalo, Detroit, Milwaukee, St. Paul, and Denver have had equally as good results, but in New York, the city where all this trouble has been experienced, is to be found the greatest practical evidence in the world that high tension currents can be and are being successfully carried with absolute and perfect safety underground.

The subways of New York at the present time contain upward of 150 miles of electric light cable; carrying all the way from 1,000 to 7,000 volts. Thirty-six miles of cable are carrying 5,000 volts or about 110 lamps of 2,000-candle power on a circuit. It has been in operation about five or six months, and during this time not one case of trouble has developed.

This cable is not a concentric or double cable, like that of Ferranti of London; but is constructed on an entirely different principle. It is composed of a tube of hard rubber, vulcanized under a pressure of 120 pounds to the square inch. The inside diameter is about one-quarter of an inch with walls about one-sixteenth of an inch thick. Over this hard vulcanized rubber tubing four cords one-eighth of an inch in diameter are spirally wound, so that they come on opposite sides. This tubing, after being thus corded, is passed through a lead press, and as the lead covering is being formed on the tubing by an ingenious device, paraffine is made to flow into the pipe, filling the space between the tubing and lead cover or pipe. The wire is drawn into the rubber tubing, the last thing. As the hole in the tubing is only about one quarter of an inch in diameter, it might seem difficult to get a number 4 wire into it, but I have seen it put through lengths of 1,000 feet with ease.

I think I have shown conclusively that wires of high tension currents can be carried successfully underground, but a problem quite as desirable to solve now presents itself, and as it is a necessity, the inventor must again be called into service, to teach us how to distribute this powerful current. I wish I could say as much in this direction as I can for our cables. The subways now built seem to be constructed in the most crude and absurd manner, with no provisions for distribution. They present evidence neither of mechanical, electrical, nor engineering skill. Imagine a water or gas main put down in our streets with no provision for supplying the buildings, so that every time a connection is to be made with a building, the pavement must be dug up to tap the main. Such is the plan on which subways are constructed in all our large cities. The subways of New York are probably the worst, though they cost more money than those of any city in the world. They are made of 3-inch iron pipes extending from street to street, terminating in manholes at each end. The pipes are laid in solid cement, thus making it utterly impossible to distribute from them, and connect direct with the buildings.

This mistake in construction was discovered after the subways were built. This necessitated digging up the streets again, and another form of conduit was placed on top of the pipes for the purpose of distribution; but even this is far short of proper and reasonable requirements, because to make connection and distribute into a building it is necessary to dig up the street to tap the wire.

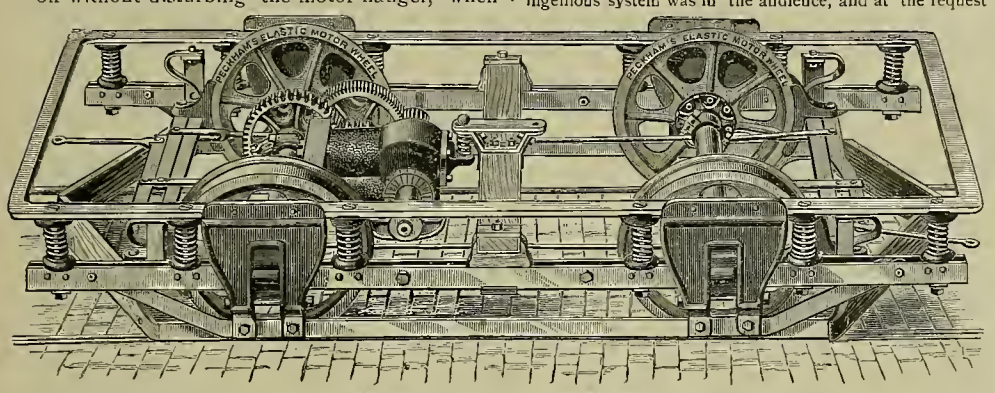
This is all wrong, and the sooner our great electricians bring to perfection this branch of the art, the more rapid will be the progress of electricity in its practical application to pressing wants and everyday needs. A subway should be constructed, the wires placed therein, and leads extending to every building for both the arc and incandescent lighting, in order that tearing up the streets could be avoided in the future, whenever a connection with a building was required. Manholes should be constructed at the intersection of every street, with the wire arranged as in a telephone exchange for the purpose of manipulation and testing. I would suggest the use of hard rubber tubes extending from street to street, just large enough to receive the wire, and ending at the manhole at street crossings in place of iron pipes. Here they could enter binding posts of proper construction, and be connected with similar wires, as desired. The central wires I would use as trunk lines or feeders, and the outside wires as distributing wires in each block. House connections should be made whether

the occupant wished the electric light or not, by looping in and out in the basement the same as water and gas are carried in with iron or lead pipes. These loops could end in a box of special construction that would be entirely safe, and so arranged that the occupant of a house or building could be furnished with the electric current almost at a moment's notice, merely by making connections. Until some such system is adopted the distribution of the electrical current will be difficult and very costly. This question of detail will undoubtedly be solved. No electrical difficulties exist; they are purely mechanical, and I predict the inventive genius of this country will master this problem at once. The necessity for quick distribution has arrived, and as we have learned to carry the high tension currents of 5,000 and 10,000 volts with absolute safety to life and property, so will we learn to distribute it with equal safety and economy.

Peckham's Cantilever Motor Truck.

The cut presented herewith illustrates an improved form of motor truck, which was designed by E. Peckham of the Peckham Street Car Wheel & Axle company, New York. This truck it so built as to prevent the oscillating motion of cars, and also to strengthen the ends of car bodies by providing additional support at each end. The main double side-bars which carry the springs, are upheld at their extreme ends by cantilever trusses. These are hung from the journal boxes by means of malleable iron yokes, to which the main side-bars of the truck are firmly united.

The motors are flexibly suspended as shown, and can be disconnected when desired, by the removal of only one nut. The center portion of the main side-bars can be easily taken off without disturbing the motor hanger, when



PECKHAM CANTILEVER MOTOR TRUCK.

it is necessary to remove armatures for repairs. The brakes are applied to all four wheels, and are controlled by compound brake levers that can be operated instantaneously, and require but little power.

The wheels are provided with malleable iron hubs, which are forced on the axles at a pressure of thirty-five tons. The wheel webs are interchangeable, and can be renewed by any ordinary workman without the aid of special machinery and without removing the motors from the axles. Tubular rubber cushions are inserted between the hub and web. The trucks are equipped with Adams' dust-tight journal boxes. The axles are constructed of fibrous steel and provided with enlarged bearings and screw threaded collar.

The wheel base of the truck is six feet. The entire length is twelve feet. The car body rests on twelve springs. This arrangement adds very materially to the easy riding of the car.

Maine Electric Light Association.

The central station electric light companies in the state of Maine held a meeting at Portland and organized a state association, Jan. 11th. The meeting fully represented the electrical central station interests of the state. The association was organized by the adoption of by-laws and the election of the following officers: President, Geo. P. Wescott; first vice-president, J. W. Wakefield; second vice-president, F. M. Laughton; treasurer, W. R. Wood; secretary, F. A. Sawyer; assistant secretary, Geo. E. Raymond; executive committee, Geo. P. Wescott, Portland; J. W. Wakefield, Bath; F. M. Laughton, Bangor; W. K. Dana, Saccarappa; W. E. Maxey, Gardner. A copy of the by-laws and an application for membership blank will be sent to every central station company in the state. It is expected that no company will be without a membership.

New York Electrical Society.

On the 11th inst. Joseph Wetzler gave before the New York Electrical society his annual lecture on "The Electrical Progress of the Year." After stating that the task he had set himself was not to criticise but to record in the concisest possible manner the leading electrical events of the year, viewed from a practical standpoint, Mr. Wetzler drew attention to the developments in primary batteries. He showed the direction in which the old Daniell cell had been improved, and described the method of Delany, who indorses the sulphate of copper and the zinc in paper bags, gaining considerable thereby, both in efficiency and convenience. Gethens, he said, had secured good results from putting a porous partition exactly at the line of the sulphates of copper and zinc, and during the year Mr. Edison had brought out a primary battery, based on the Lalande primary battery, which dated some years back. The progress in storage batteries had not been, he said, so striking as that shown in some other branches, but still marked developments were to be recorded. In the Lugo cell, in which spongy copper highly absorbent of gases was employed, the plates were so prepared as to admit of the actual storage of the oxygen and hydrogen given off by the decomposition of the electrolyte. Among the systems of distribution coming into vogue, where the storage batteries were placed at sub-stations and could be regulated entirely independent of the main station, Mr. Pfatischer's might be mentioned, he said, which entails the use of a polarized relay and the momentary interruption of the charge of the circuit which operated the regulating devices. After touching on the Webster method of treating sewage electrically, by which the complete decomposition of the organic matter is promptly effected, the lecturer passed on to the subject of telegraphy. He remarked here that the order in which the various branches of his subject were treated must not be regarded as indicating in any way their relative importance. The recent interesting developments in synchronous multiplex transmission were next alluded to, beginning with that of Lieut Patten, by which twenty-four messages could be transmitted. The inventor of this ingenious system was in the audience, and at the request of the lecturer described and illustrated on the blackboard the principles of his invention. The line adjusting system of Delany was described, in which admirable adjustment is insured, and the delay and confusion incident to the breaking in on the line of an operator in bad weather are obviated. In the Delany automatic perforator, instead of the deep indentations of the Wheatstone system, the marks, which are not actual perforations, are made directly by an apparatus worked by a Morse key, and the paper is afterward passed through a transmitter in the usual way.

After detailing the principle of the telemeter, by which the height of a receiver at a distance, or the temperature of every room in the largest building can be recorded and automatically regulated, the lecturer described, under the head of telephony, the phenomenal exhibition of the degree of perfection to be obtained in the transmission of sound, given by W. J. Hammer in his experiments between New York and Philadelphia. On that occasion speech, after being recorded on the phonograph in New York, was repeated by a carbon transmitter, transferred over a line to a motograph receiver in Philadelphia, reproduced into the phonograph, again repeated by the carbon transmitter, transmitted to a local motograph receiver, and then given with clearness and but slightly diminished volume, to the audience. The loud speaking telephone of Charles Selden was also explained.

In entering on the treatment of the applications of and improvements in the use of the alternating current, the lecturer said he was surprised, in looking over the notes he had prepared for the lecture, to see how largely the applications of the alternating current exceeded those of any other department. In connection with the distribution and generation of electricity, reference was made to Acheson's calelectric generator, and a comparison drawn between it and the recent modification by the same inventor, in which the generating capacity of the transmitter was increased by the application of heat. In the matter of transformers, the complaint of the poor efficiency secured at small loads, Mr. Wetzler said, had been overcome by Mr. Swinburne, who had designed an open circuit transformer, instead of the closed circuit transformer. He called his new type the "hedge hog," and claimed that for average loads it showed higher efficiency than the type it is intended to supersede. The Paget transformer was also alluded to

Premising that a method of obtaining continuous currents from alternating currents without the intervention of a commutator, had been the problem of electricians for a long time, the lecturer described the solutions arrived at by Mr. Tesla, and reference was made to Prof. Elihu Thomson's constant current regulator, by which a continuous alternating current strength could be maintained. Lieut. Patten here gave an explanation of his 3-wire distribution, in which the positive current is passed over one wire and the negative impulses are passed over the other, but both are returned by the central wire. The result is that any continuous current apparatus can be placed in connection with the circuit, which may on other occasions be used for alternating current apparatus. Storage batteries, or motors, or any device that requires constant current for the maintenance of the magnetism, can thus be operated. The new Edison marine dynamo, which has eight poles, the four north poles being on the outside ring and the four south poles on the inside, was here alluded to, and the lecturer then proceeded to speak of the electric motor, and requested Mr. Crocker, the president of the society, to give an explanation of his new system of motor regulation, after which Lieut. Patten described his alternating current motor. Mr. Wetzler here referred to the principle recently defined by Mr. Tesla with regard to the maximum capacity of which the motor is capable. Though the originality of the principle had been disputed, Mr. Tesla was no doubt the first to announce it in set terms.

While on the subject of electric railways, the lecturer described the Bentley-Knight conduit system, in which the slot is used at the side of the track, instead of in the center, as formerly. Attention was also drawn to Weems' system of rapid transit, and Mr Wetzler stated that he had timed a Weems car, watch in hand, when it was going at the rate of 120 miles an hour. The pointed ends of the car were so made as to minimize the enormous resistance of the air which is met with at such high speeds. The port-electric or "sucking" system of rapid transit was also described and illustrated.

Brief reference was made to the measuring instruments brought out during the year, among which were mentioned the Blythe electric torsion balance, the Ayrton & Perry twisted strip voltmeter, Mr. Pfannkuche's alternating current meter, and Prof. Elihu Thomson's method of generating a current in a secondary coil which should be equal to the square root of the current in the primary This instrument is used in conjunction with his oscillating electric meter. This was followed by a rapid grouping of many of the improvements made during the year. The lecture was very well attended, and among the speakers at its close was Prof. George Forbes.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 18.—The subway explosions in Sixth avenue in two different places which occurred Wednesday, was the second disturbance within a week in this subway. The large vent in the subway at Fourteenth street where the explosion occurred last Saturday evidently lessened the force of Wednesday's disturbances and there were no serious consequences. The arc light at the corner of Seventeenth street was seen to spark and sputter immediately before the explosion, and immediately after the explosion all the lights were temporarily extinguished. The Subway company claims that it was the electric light wire that caused an ignition of the gases in the subway while the electric light company claims that the sparking and sputtering of the arc light was due to the presence of gases in the subway, which finally put out all the lights for a time.

Lineman John Cunningham who cut down Lineman Feeks after he received his fatal shock on the telegraph pole has a suit pending against the East River Electric Light company for $2,000 damages on account of an accident to him in falling from a pole.

Harold P. Brown's mandamus is denied by the courts and Judge Lawrence is disposed to think that the act establishing the Board of Electrical Control took away from the Board of Health "all power in respect to electrical conductors in the city of New York." He claims that the applicants have no "clear legal right to demand what is asked for" in the writ. The Board of Health "has acted in the matter and has exercised its discretion and judgment in respect thereto, and with the exercise of that discretion the court cannot interfere."

Mayor Cleveland of Jersey City has signed an ordinance permitting the Bergen Electric Light company to erect poles and string wires all through Jersey City. The same day a wire in Bay street sagged until it rested on a wire of the New York & New Jersey Telephone company and eight telephones of the Board of Public Works were burned out by the current from the electric light wire. Three fires it is claimed, were started from burning telephones. Chief Ruggles received a shock in attempting to remove a burning telephone.

Heinrichs who was not permitted to testify at the coroner's inquest or before the grand jury in the case of Harris who met his death by an electric shock, has written Governor Hill and the legislature, that this was a suppression of evidence by District Attorney Fellows and Coroners Schultz and Messemer. The grand jury rebelled when expert evidence was suggested, as they said it was confusing and they wanted facts and these were presented by Dr. Moses, R. W. Pope, and Mr. Edison.

Commissioner Gilroy has reported that all dangerous and badly insulated wires which the Board of Electrical Control has designated, have been cut. Dead wires will now be gotten rid of by the commissioner and the companies in conjunction.

The meeting of the New York Electrical society held Jan. 11th at Clinton Hall was attended by a representative body of electricians who listened to the interesting lecture on "The Electrical Progress of the Year" by Joseph Wetzler. The lecturer went very exhaustively over the ground covered by the latest developments in telegraphy, telephony, primary and storage batteries, the electric light, and motor applications, both with continuous and alternating currents. At the close of the lecture Prof. George Forbes gave an interesting account of the progress of electricity in England where he said electricians are now emulating the example of their American cousins.

The Board of Electrical Control has had its day and the public has had a bitter taste of politico-electric science. It has lined the pockets of its favorites and left the city in the worst imaginable condition with its impracticable subways. An important bill has been introduced in the state senate by Mr. Roesch providing for the dissolution of the present Board of Electrical Control in New York and the creation of a State Board of Electrical Control which shall have charge of all electrical matters in the state.

The Gas Fixture Manufacturers' association which was formed last July, will probably be reorganized. It is well known that members of this organization have been cutting prices, and it is therefore proposed by leading firms in this section to make a number of important changes. It is further reported that several smaller establishments will be combined under one management.

Business in this city was affected seriously last week by the breaking of telegraph lines. During the storm all messages that were received at the telegraph offices were subject to delay.

The State Civil Service Commission has been asked by the Board of Electrical Control to hold examinations for candidates for three inspectorship vacancies.

The regular annual discussion on the probability of the organization of an electric light trust is now under way in this city, and to all appearances there is no more excuse for it now than heretofore. It is probable that the entire matter is idle newspaper talk.

Complaints against the Board of Electrical Control are increasing daily, and frequent communications from citizens appear in the daily papers. Here is a conservative view: "How buildings should be wired and electric plants installed should properly be the business of the Board of Electrical Control. Had this board been composed of qualified electricians, rules would doubtless have been adopted before this which would have rendered the occurrence of fires almost an impossibility, and saved millions of dollars." In relation to this matter the *World*, which has been devoting considerable attention to the subject, says: "Not one human life was sacrificed to the electric light currents in New York until the Board of Electrical Control inaugurated its ignorant and reckless plan of regulating the wires so as to make business for the Consolidated Telegraph and Electrical Subway company." W. H. T.

Milwaukee, Wis.

MILWAUKEE, Jan. 18.—The controversy over the Hinsey electric railway line has assumed a new aspect. The mayor and city attorney have taken a hand in the matter, and if an attempt is made to start the road with the present poles and wires, measures will be taken immediately to prevent the cars from running. Mayor Brown addressed to City Attorney Elliott a communication Thursday, in which he charged the company with having violated the terms of the charter authorizing the construction of an electric line, and concluded as follows: "I have to request that you will take such steps as may be necessary to enforce the rights and protect the property of the city and its citizens." The city attorney accordingly notified Mr. Hinsey that he would take such measures as would insure a compliance with the terms of the franchise unless the company immediately complied with the directions of the Board of Public Works. The meaning of this notice is that Col. Hinsey must proceed at once with the removal of the present poles and the erection of new ones, stronger and higher and that he must provide for a return metallic circuit. The mayor, city attorney and board of public works held a conference and decided to apply for an injunction should an attempt be made to operate the present line, and the matter will be fought out in the courts. It is claimed by the mayor that the construction thus far has been of an inferior grade and that the poles are not as tall as the specifications in the franchise provide for. On the other hand, Hinsey says he will give the people of this city the best street railway service in the West, and that the entire plant will be satisfactory when completed. Hinsey is supported by the council of which he is president, while the mayor relies on the board of public works, the members of which hold their office through his favor. This would indicate that the controversy is developing into a fight for political supremacy. S.

San Francisco, Cal.

SAN FRANCISCO, Jan. 9.—The fire department committee of the board of supervisors of this city recommended recently the passage of an ordinance for the immediate removal of wires from the house tops and roofs of buildings with the exception of the fire alarm wires. The ordinance provides that the wires must be removed within ten days after due notice has been given by the chief engineer and any failure to comply with the order is punishable by a fine of $500, or imprisonment of six months or both, unless the privilege is given by the board of supervisors to maintain the wires. Apparently this measure is aimed at the Electric Improvement company which, when refused a franchise, strung its wires over house tops.

Sacramento is out in force on the electric light proposition. At the meeting of the trustees Dec. 30, W. C. Clark of the Westinghouse company and representing capitalists from San Francisco requested a franchise for fifty years, offering at the same time to furnish one hundred and twenty-five arc lamps, in ninety days at a charge of $14.95 per month. He stated at the same time that he did not want the franchise unless it came with the city contract. This proposition, after a very stormy debate was accepted, with the stipulation that he could not sell out to the Capital Gas company without forfeiting the franchise. The mayor gave notice that he should move to reconsider the franchise at the next meeting. The point that seems to be the sore one is that the meeting was called for the purpose of opening bids for the city lighting and no one except the Capital Gas company had put in such a bid, and it is claimed the trustees had no right to award the contract to Clark without his having put in a bid. The Capital Gas company formerly got $51 per month for a mast of three lamps. The fever for city electric light plants inaugurated by Oakland, and agitated by Sacramento, has now reached Stockton. At the last meeting of the trustees it was decided to find out the cost of a plant sufficient to light the city.

Fairhaven a town situated on the Sound about thirty miles from Seattle, Wash., is having a boom. An electric railroad and an electric light plant are projected.

W. G. C.

Louisville, Ky.

LOUISVILLE, January 18.—By February 1, Hiram & Gooch expect to have a new electric light plant in operation in the central part of the city, between Main and Market and Fourth and Fifth streets. They have already made contracts to supply 3,000 incandescent lights. The additional plant is needed since the city has only two plants, and one is of small capacity. Two or three squares only are now lighted by electricity on Main, Market, Jefferson, Green, Third and Fourth streets. The other streets are still half lighted by gas.

The Western Electric company of Chicago has contracted to supply the Louisville hotel with electric lights. The rotunda will be supplied with arc lights and the bedrooms with incandescent lamps.

The Louisville Gas company, which has the exclusive privilege of furnishing the city with gas, will apply to the state legislature at the present session for an amended charter permitting it to operate an electric light plant. The electric light companies now in operation will strongly oppose the application.

The state legislature has passed a bill imposing a penalty of not less than $10 nor more than $100 for damages to telephone posts or lines.

Telegraph wires are being strung on the line of the Louisville, Hardensburg & Western railway.

The Thomson-Houston company is preparing to supply with electric lights the caisson of the Louisville & Jeffersonville bridge, in which thirteen workmen were killed last week.

Frederick Stitzell, assignee of the American Semaphore company of Louisville, has secured a patent on an electric semaphore setting apparatus.

Electric lights will take the place of gas on the bridge between Covington and Newport, Ky. B. A.

Denver, Col.

DENVER, Jan. 18.—Judge Rising has decided the injunction case of the Denver Tramway company against Mayor Londoner and Chief of Police Farley. The suit was begun to enjoin the defendants from interfering with the construction of an electric railway. The plaintiff claimed the right to operate an electric railway by virtue of an ordinance passed in 1885, and certain ratifications of that ordinance by the city council in 1888. It was claimed by the defendants that the original ordinance was absolutely void. The judge decided against the Tramway company on every point. The attorney for the company said the company would appeal from the decision.

J. W. Strayer hopes to construct an electric road in that part of the city lying north of East Colfax avenue. He says that nothing definite is yet arranged, but that the interested parties are formulating a scheme.

Prof. A. Graham Bell of telephone fame responded to the toast of his own name at the first banquet of the Exchange last week. He said:

GENTLEMEN—I must thank you for your welcome to Denver and Colorado. I am afraid my object has been misapprehended. A few days ago I was dropped down in Denver on my return to my native state. The grip attacked me, and I stopped here to try your climate. I shall return home without having seen buffalo, deer, or cowboys, and I have not been shot at while in Denver. I can say that I admire the enterprise and push of the citizens; that this city has grown so fast, is a wonder to me. I have read in the *Forum* that Colorado has been the home of man for countless ages; men who built houses of strong mortar and irrigated the soil before white man made his appearance. A writer for the *Forum* also said that the length of time man has inhabited Colorado cannot be measured by centuries. Man measures time by the light of the world. Greatness and smallness, nearness and farness are similar terms; far is near to wings of light, near is far to wings of sound. You can produce sound by sunlight; you can transmit speech along a beam of light. It may occur to you that you would like to know how this is done. I will explain. Take a disk of metal with holes in the circumference, catch a beam of sunlight by means of a mirror, revolve the metal, cut the light by rotation of the disk of metal and the interrupted beams of light will produce sound. To produce speech by beams of light, catch the light with a mirror so thin that it will vibrate, reflect the beam of sunlight a distance from a bottle filled with a small amount of carbon, speak on the back of the mirror. The vibrating mirror will be alternately convex and concave. A man at a distance receiving the beam of light, and with the varying of that beam of light, the sort of speech and audible tones of the person speaking can be heard by the one at the distance. If you had a bottle with that sort of solid in it, and should speak against my radiaphone, you would hear my thanks for the honor you give me of appearing at this banquet.

P.

Omaha, Neb.

OMAHA, Jan. 18.—The Council Bluffs, Ia., Telephone company is putting up a metallic circuit between the city and Omaha. There has been much complaint since the motor line has been in operation, and during the day when all the trains were running, it has been almost impossible for subscribers to communicate.

The board of directors of the South Omaha Electric Light, Heat & Power company met last week and partially organized. No president was elected. C. M. Hunt was elected vice-president, C. W. Key treasurer, and John A. Doe secretary.

"Do you see those poles and cross arms in the alley?" asked President Wiley of the Thomson-Houston company of Omaha, when asked about electric lights for the streets. "Those are the first for our new line. They have insulators for thirty-six wires to feed arc and incandescent light, and supply power to machinery." The company's contract with the city calls for the starting of 100 arc lights at street intersections by February 10, and Mr. Wiley promises that they will be ready. A large number of small factories now using steam or water motors are arranging to put in electric motors next month, which will be operated by the Thomson-Houston circuits.

J. B. Stoddard, respresenting the Sperry Electric Light company of Chicago, and James Riley, traveling expert for the same company, were in Council Bluffs, Ia., last week, to inspect the new Sperry lights and dynamos. The work of setting up the machinery and erecting the new lines and lights was done under the direction and personal supervision of Superintendent Harry Evans. The new lights have given satisfaction in every respect. The only change that remains to be made is to "cut in" the three new towers to the circuits already in operation. H.

Boston, Mass.

BOSTON, January 18.—It is evident that the Boston Electric Light company will not release its hold upon the city contract without a very emphatic protest. In this desire to continue its service to the city, at a price to be fixed by the state board of gas commissioners, the company is strongly upheld by the fire underwriters and nearly 140 influential business men and firms interested in the district over which the company's wires are strung. Two remonstrances from these business men were presented to the board of aldermen on Monday night of this week, protesting against the transfer of the contract to a new company, on the ground that the decreased cost of light would be much more than offset by the increased danger arising from the duplication of all the overhead high tension wires. This phase of the protest was met by "An Open Letter to Mayor Hart," which appeared yesterday in all of the daily papers, and in which the Suburban Light & Power company, to which the contract has been let, announces its intention to put all of its wires underground in the business part of the city. This has called forth a reply from the

opposition party proclaiming the dangers of underground wires of high tension, the damage to the city from the necessary street excavations and the uncertain nature of such a service.

As to the system to be used by the new company, it says: "The wires will be laid upon a simple system, after the most approved manner, it being the intention to use a new and improved apparatus, free from the dangerous features that have heretofore accompanied high tension electric lighting. There being no direct electrical connection between the underground mains and the lamps, thereby guarding from the danger from fire that is incidental to all systems where direct connection is necessarily made from the mains to the lamps." It is claimed that the lamp to be used will burn for 32 to 36 hours with a single carbon. The system is entirely new and it is said to be that announced by Mr. Westinghouse some time ago.

The board of aldermen has had its share of electrical business this week. At its meeting on Monday night, in response to a second appeal from Mayor Hart for immediate action, an order was passed "that a joint special committee, consisting of five members of the board of aldermen with such as the common council may join, be appointed to consider the subject of superintendence of electric wires in the city of Boston." The Suburban Light & Power company petitioned for the right to erect and use 1,000-horse power of stationary engines, and the Walworth Light & Power company to lay or erect wires over or under the streets of Boston. The common council order for a report on the cost of maintaining and operating a city plant also came up for discussion and was referred to the committee on lamps, where it will probably "rest in peace." To this same committee was also referred a rather remarkable petition from the aristocratic owners and occupants of houses on Commonwealth avenue asking that gas lamps be restored to that thoroughfare. This is conservatism with a vengeance.

In the common council meeting last night, the councilmen concurred in the order given above for the appointment of a committee to consider the subject of the superintendence of electric wires, and further ordered that this committee considered it advisable to reduce the voltage of overhead electric light wires to 500 volts.

The daily "grist" of the state legislature, now in session on Beacon Hill, also contains its share of electrical bills and orders. Among these are one advocating "better protection to the public against danger from electric light wires used or kept 'alive' during the daytime," and one for securing "supervision and control of overhead or underground electric wires, with such safeguards as may be required to properly protect lives and property." Both were referred to the committee on mercantile affairs.

The West End Street Railway company, through its president, Henry M. Whitney, has applied to the legislature for authority "to locate, construct, maintain, equip and to operate by electricity or other motive power an elevated railroad." An exactly identical petition was to-day presented by the "Meigs Elevated Railway company." The indications are that the West End company is to be bitterly opposed, and it was reported at the state house yesterday that representatives of the Manhattan system in New York were in town making plans for an attempt to capture the charter for itself.

Two new electric car lines on the West End road will be put in operation to-morrow morning. The first will be an extension of the line now running between Grove Hall and the Tremont House, and will hereafter be run past the Tremont House around the loop to the depots formed by Hanover, Causeway, Portland, Merrimac and Sudbury streets. The cars on this line will be run at intervals of five minutes. The second line to be put into operation to-morrow is that from Dorchester to the Tremont House. The cars will stop only at designated streets about a quarter of a mile apart, and conductors are instructed "not to wait for passengers coming from a distance." Gates will be used on all electric cars to prevent passengers getting on or off the cars on the side next the other track.

The advertising agent of an opera company thought he had played a shrewd trick on the West End Street Railway company on Sunday morning two weeks ago when he had the span and guy wires of the electric lines on Tremont and Boylston streets and Park square hung with gay colored posters announcing the advent of the company at one of the theaters. After ascertaining the offenders the company rendered a bill of $21, the expense incurred in removing the hangers. This was paid at once and was promptly followed by the arrest of the two guilty men on a charge of defacing private property. They were to-day fined $10 each in the municipal court.

The price of incandescent lights has been reduced by the Edison Illuminating company in this city from 1¼ to 1 cent per hour for 16-candle power lamps and for other candle powers in the same proportion. The new schedule of prices will take effect February 1.

A large fire occurred this morning in the boot and shoe district of this city destroying the building of Claflin, Coburn & Co. As was to be suspected an electric light wire is accused of starting the fire because "there was nothing else in the building that could have started a fire."

The election of the board of directors of the Weston Illuminating company of this city took place on Wednesday of this week, resulting in the choice of F. L. Higginson, president; A. Roheson, secretary and treasurer; Moses Williams, Charles Storrow, and H. L. Higginson.

The regular quarterly meeting of the New England Electric exchange was held last Monday at the rooms of the Boston Electric club. The secretary's report showed that since the formation of the exchange there had been 343 applicants for license, 247 licenses issued, thirteen candidates rejected and two not examined. No business of importance came before the exchange.

The war department of the United States government has ordered a Thomson welding machine for the Watervliet arsenal at Troy to be used in welding wire for the manufacture of rifled cannon. A commission from the navy department is expected in Boston in February to examine the electric welding process and report upon its adaptability to the welding of boiler flues, etc., for the government cruisers. This commission will also test a chain welder for the Charleston navy yards.

George Westinghouse, Jr., was registered at one of the hotels in Boston on Saturday last. O. H. M.

THE ELECTRIC LIGHT.

Seymour, Ind., has a new electric light plant.

An electric light plant is being installed at Bedford, Ind.

A company has been formed to establish an electric light plant at Vernon, Tex

The Pioneer Mining & Manufacturing company, Thomas, Ala., is enlarging its electric light plant.

The Ball Engine company of Erie, Pa., has furnished a complete steam plant of 100 horse power capacity to R. Mugge of Tampa, Fla. The power is for a Heisler Electric plant.

The Central Thomson-Houston company of Cincinnati is putting in a complete electrical plant for the DeCoppet Ice company of Somerset, Ky. The steam plant is furnished by the Ball Engine company

The Rapidan Water & Electric Power company at Rapidan, Minn., has been organized. The capital stock is $100,000. The incorporators are Seth H. Baker, Rapidan; George F. Piper, Mankato; Clarence H. Piper, Garden City, and J. C. Washburn, Mankato.

The Chicago Edison company has just completed the wiring of the Winslow Bros. Manufacturing company's building, Chicago, for 250 incandescent lamps. The contract for an Edison dynamo has been awarded to the same company, and the machine will be installed next week.

At a recent election at Boonville, Mo., the citizens voted in favor of contracting with the Boonville Electric Light & Power company to light the city for ten years. The company will erect a station at once. One of the officers of the company writes: "What we want now is a good plant."

Mayor Callahan of San Antonio, Tex., has had a conference with representatives of the electric light, telegraph and telephone companies doing business in the city, and served notice on them that if they failed to agree on elevating their wires to a uniform height, he would follow the example of Mayor Grant of New York, and cut their wires.

Among the contracts for central station alternating current apparatus already reported by the agents of the Westinghouse Electric company for the month of January, are the following: For Red Oak, Iowa, 750 lights; Allentown, Pa., 1,500; Elmira, N. Y., 750; Jacksonville, Ill., 750; Maryville, Mo., 750. All of these orders are for new plants except in the case of Elmira, which is an increase. The original plant was installed there during the latter part of the year 1889.

The Fremont, O., Electric Light & Power company is preparing to make extensive additions to its electric light plant. As soon as the weather permits, the electric light station will be moved to the present gas works. New boilers and engines of 350-horse power will be put in, new buildings, dynamos and other machinery will be added, and the station will be a model one. These improvements will cost from $12,000 to $15,000. The company is also extending and improving its lines.

A meeting of the companies doing business in the state of Michigan was held at the office of the Brush Electric Light company, Detroit, January 17th, for the purpose of organizing a state association. The attendance and the response from companies throughout the state was good. The desirability of organizing such an association was agreed to without dissent. The association organized by adopting by-laws and electing the following officers: President, Geo. Peck, president Edison Illuminating company of Detroit; vice-president, Jas. R. Dee, general manager of Peninsular Electric Light & Power company of Houghton and Hancock; secretary and treasurer, Joseph E. Lockwood, general manager Brush Electric Light company, Detroit; executive committee—George Peck, Detroit; Jas. R. Dee, Houghton; Joseph E. Lockwood, Detroit; W. H. Powers, Grand Rapids. The secretary was directed to send a copy of the by-laws and a blank application for membership to every company in the state. The association will give its first attention to the establishing of a general system of rules and regulations for the wiring of buildings, so as to secure the safest and best construction and service.

The formal opening of the new salesrooms of Lyon, Potter & Co., Chicago, last week, was an event of more than usual interest to the music-loving public of Chicago. This firm has fitted up an immense building on Wabash avenue, Chicago, in the most elaborate style, making it one of the finest establishments in the western metropolis. The facilities for lighting this large establishment are in keeping with the other appointments. The Chicago Edison company, to which the contract was given, wired the salesrooms for 250 lights. These are supplied with current from the company's central station. At the main entrance an 18-lamp ball cluster attracts considerable attention. In the main salesroom on the ground floor the lamps are arranged on pillars. The fixtures are of special design, in the form of bands about the pillars, and each contains six lamps. The other salesrooms are lighted by four light clusters, also specially designed. Among the special features that attracted considerable attention on the opening night was a mound of flowers in which were arranged 20 3-candle power lamps in series. The effect of these lights among the flowers was indeed striking, and attracted considerable attention.

The London *Electrical Review* speaking of the wire cutting in New York, says: "In England, owing to the liberal policy of the Board of Trade, no similar drastic measures have been taken, and the 'model order' of Major Marindin, which stipulates that in future all electric light conductors shall be placed underground, and that those already carried overhead shall within two years from the issue of the regulation be laid underground has, with the exception of one or two minor points, met with general approval. The fact that this policy has been followed in this country, and that almost similar steps have been taken in New York, has caused the governments of other countries to consider the subject. The German government is now taking action in the matter, and has just decided to put underground all the telephone, telegraph and, we also believe, the electric light wires. In Paris most of the electric light cables are laid underground, but in the French provincial towns they are generally run overhead. This state of affairs prevails also in Spain, and to a certain extent, in Austria-Hungary. The most recent to take action in this direction is the Italian government, which has just adopted a policy by which the telegraph and telephone wires, the latter of which the government proposes to acquire, will be protected from the influence exerted upon them both by the induction from and contact with electric light and power cables."

THE ELECTRIC MOTOR.

The Anniston, Ala., Street Railway company will adopt an electric system on all its lines.

It is stated that the Union Street Car company of St. Joseph, Mo. proposes to experiment with a storage battery system.

A party of Montreal capitalists visited Boston last week and examined the West End electric railway system, with a view to introducing similar service in their own city.

The Brooklyn Street Railway Company of Cleveland Ohio has just installed two 125 horse power engines, making 14 Ball engines of this size now in its two power stations.

The Keokuk, Ia., Electric Street Railway company has asked for an exclusive franchise for operating electric street cars in that city. The company has a capital stock of $100,000 and expresses a willingness to equip a first class line.

President Allen of the Business Men's association of Davenport, Ia., at the annual meeting, called attention to the fact that the city has a water fall of a capacity of 10,000-horse power, which could be utilized by the use of electric motors.

The Birmingham, Ala., Street Car company has been granted permission by the city council to experiment on its lines with storage batteries. Much interest is felt in the development of electricity as a means of propulsion for street railways.

An effort is being made to introduce an electric street railroad into Grand Forks, Dak. The Northwest Electrical Construction & Supply company of St. Paul, Minn., is endeavoring to secure the franchise, and many wealthy local citizens are championing its cause.

The city council of Pueblo, Col., has granted a franchise to the Pueblo City Railway company for the construction of twenty-two miles of road to be operated either by cable or electricity. Work is to be commenced within thirty days and completed through the business streets inside of six months.

The question of rapid transit and better street car facilities has agitated the people of Memphis, Tenn., for years. The present system of horse cars is a miserable failure as far as modern accommodations, time and service are concerned. Three months ago, when a company was organized to introduce rapid transit into the city, the movement was hailed with delight. It was proposed by the new company to build an electric street railway, touching every important point in the city, and a franchise was granted the projectors of the enterprise by the legislative council. A representative of the Sprague company recently invited representative business men to visit Cincinnati and other cities and examine the electric roads in those places. In every instance the visitors have

become convinced of the desirability of introducing the electric system, and the outlook for rapid transit in Memphis is certainly very good.

The Thomson Houston Electric company has just closed a contract with the Street Railway company of Fort Worth, Tex., to furnish that company 15 motor cars and the requisite generating apparatus. It is provided that the system shall be in operation May 1st. Under this arrangement the system with which experiments have been made will be abandoned.

A survey has been made and the right of way obtained for an electric railroad from a point on Hudson street, Rochester, N. Y., to the Sea Breeze, a summer resort on Irondequoit bay. The line will be six miles long, and it is hoped the cars will be running at the opening of the season. This will make the third electric road from Rochester to summer resorts in the immediate neighborhood.

In an interesting article on coal-mining machinery in the *Black Diamond* the following paragraph appears: The past year has seen great advances made in the science of electric power and improvement in the manufacture of electrical machinery for coal mining and other purposes. It has opened a prospect in the future of cheaper mining and an extension of trade by diminishing the cost for absolute labor, thus placing this country in a far better position to compete with other lands in the trade marts of the South. Since the Gramme dynamo was introduced in 1870 the development of dynamic power has been steady and continued, and to-day its value is being appreciated the wide world over. The number of electrical machines that are being placed in coal mines, the great attention which they are receiving from every operator of account, and the immediate saving in the working expenses of a mine which their advent effects, stamp them as being a common mining factor in the future. With their perfection the cost of coal production will be so lessened that coal as a fuel will vie in point of economy with certain fuels which under highly-favored circumstances now displace its use in various sections of the country.

Miscellaneous Notes.

The Central Electric company of San Francisco has been incorporated with $250,000 capital to construct and maintain electric apparatus in the cities and towns of the Pacific coast; directors: C. F. Fargo, J. Redding, L. L. Baker, G. P. Adams and C. H. Wilson.

Oscar Williams, whose death at Hartford, Conn., Wednesday, January 15, was due to an electric shock, was a victim of his own carelessness and folly. Along the west side of the factory where he was employed ran two wires of the Hartford Light & Power company, so near a second-story window that one can reach down and grasp them. The workmen in the factory had been in the habit of thus reaching down and receiving slight shocks. The electric company found this out and sent a warning to the establishment, and the practice was ordered discontinued. Williams, however, disregarded the order and Wednesday went to the window, and leaning out, grasped the wires. He leaned over a steam radiator, and a circuit was formed. Instantly he uttered a piteous shriek, and two employes ran into the room, and seizing the unfortunate man by the legs, pulled him by main force off the wires in through the window. He was unconscious, and died in less than ten minutes. Two fingers of the right hand were burned to the bone.

The following will be of interest to medical men: At a recent meeting of the Harveian Society in London, Dr. Cagney said that experiments by Eulenburg, von Bruns and Hermann Munk had shown that certain drugs could be made to pass through animal tissues by the action of a galvanic current, and he himself had used iodide of potassium in this way for the cure of lead palsy. Only very small doses, however, could be administered through the skin. The method was best adapted for the treatment of diseases of the skin and mucous membranes, or of small tumors immediately beneath them. In the application of the method a very strong current was not needed, but a sufficient current density was required, and the tissues under treatment must be brought directly in the path of the current. The electrodes might be either sponges holding solution of iodide of potassium or a modification of Dubois' conducting tubes filled with the fluid. The electrode should be of large surface area. The fluid should be a saturated solution of iodide of potassium, and it ought to be supplied, where possible, at both poles. Where this was not possible the solution should be at the negative pole. The current should be passed for 10 to 15 minutes, and its strength would be determined by circumstances. Its direction should be reversed every minute.

THE TELEGRAPH.

David Dougherty, of the Postal Telegraph Cable company, said recently: "A glance at the table of charges of the Commercial Cable company recall's Puck's declaration that he could put a girdle about the earth in forty minutes. There seems to be no portion of the globe where civilization has not obtained a foothold. Messages can be sent from extreme of the fixed rate to New York, and thence by transatlantic cable to Great Britain, Ireland, France and Germany, to Algeria, Morocco, Tripoli and Tunis on the northern coast of Africa, for from 8c to 27c per word. Delagoa Bay, Mozambique, Zanzibar and the Transvaal in South Africa can be reached for $2.16 per word. There are twenty-eight telegraphic stations on the west coast of Africa, the tariff ranging from $1.45 to $2 per word. In South America, the Argentine Republic, Brazil, Chili, Colombia, Ecuador, Paraguay, Peru and Uruguay are reached from England by twenty-eight stations, the charges ranging from $1.40 to $4.70 per word. All portions of Arabia, Australia, China, Cochin China, Corea, Ascension Islands, Corfu, Corsica, Cyprus, Canary Islands, Greek Islands, Herzegovina, India, Japan, Java or Sumatra, Liberia, Persia, Philippine Islands, Siam, are reached by telegraph direct, and telegrams are mailed from these points to all known countries. The highest price charged is $11.76 per word to South Persia. Cipher dispatches are prohibited to Turkey, both in Asia and Europe, Roumania, Tripoli, Servia and several other countries. All messages to the Orient must be written in French. It wants but a trans-Pacific cable to complete the girdle about the earth."

Personal Paragraphs.

Allen R. Foote, who has charge of the department of electricity for the eleventh census, was in Chicago last week.

H. Ward Leonard of the United Edison Manufacturing company, New York, attended the meeting of the Chicago Electric club Monday evening.

Paul C. Just, formerly with the Thomson-Houston Electric company, Chicago, has accepted the position of electrical engineer for the North Chicago Street Railroad company.

Asa T. Soule, who died at Rochester, N. Y., last week, was the originator of the electric railway between that city and Ontario beach, which has proved such a boom for electric roads in that section. Mr. Soule held about half the stock of the electric company.

Business Mention.

The Electrical Supply company, Chicago, has just issued a neat circular calling attention to special lines of goods which it is now handling.

Hansen & Linehan, of Dubuque, Iowa, write the WESTERN ELECTRICIAN under date of January 17, that they are about installing an Edison electric light station, and will need from 15 to 25 tons of bare copper wire

G. W. Lord's famous boiler compound is finding a large field in the West. The Magee Brothers of Chicago and St. Paul have recently ordered two car loads of this cleansing compound which is being so largely used in all the steam plant districts of the country.

Mr. Biddle, who has charge of the electrical department of Jas. Queen & Company, Philadelphia, reports a large and increasing business in electrical testing instruments. The new catalogue just issuing comprises many new instruments of interest to electricians generally.

H. T. Paiste is now located in his new and commodious quarters at the corner of 12th and Market street, Philadelphia, and reports an increasing business. His well known switch is now universally popular. He is at work upon a new electrical device which he will shortly present to the electrical public.

The rapidly-growing business of the Southern Electrical Supply company has compelled them to move from their old quarters at 310 North Third street, to the commodious five story brick building at 823 Locust street, St. Louis. This comparatively new concern seems to be achieving a gratifying success.

L. J. Wing has purchased the interest of the Simonds Manufacturing company in his fans, engines, etc. He has established new headquarters at 80 John street, New York city. The Western department will remain in charge of W. H. Wissing, and the headquarters will be at 96 Lake street, Chicago.

The Elektron Manufacturing company which manufactures the Perret motor, has just begun the manufacture of an incandescent machine after the improved pattern of Mr. Perret, whereby a very low rate of revolution of the armature is reached so that direct coupling with the many new high speed engines can be successfully maintained. This is a very ingenious machine and is characterized by fine workmanship.

The Fletcher & Fletcher Electric company of Cleveland, O., recently introduced an improved form of dry battery, and are receiving complimentary notices of work. Substantial assurance of the success of the battery is furnished in the large and increasing orders that have of late been received. It is known as the Excelsior dry battery. It is compact, perfectly sealed, has a high electromotive force and low internal resistance. Its power of recuperation is a special feature.

The Central Electric company, Chicago, has removed to its new building, 116 and 118 Franklin street, where, with increased facilities for carrying a larger stock and more diversified line, and for making shipments more promptly and with greater care than formerly, it hopes to ascend even higher in the scale of perfection. This company has had a remarkably successful career, and its prosperity is due largely to the strict business methods which it employs and the high line of goods it carries.

Since the numerous tests and experiments with the new arc light system of the Westinghouse Electric company have attested its excellence, the company has decided to extend the arc light business as much as possible. The works in Pittsburg are now being enlarged, and all the detail work is now removed either to Newark or New York to give more space to arc light work. The new six-story building which is taking the place of the structure which burned down several months ago, is to be exclusively utilized for the manufacture of arc lamps. The socket department was last week removed to Newark, to make needed room in the works.

H. A. Glasier, well known throughout the West from his long connection with the Jarvis Engineering company, as western manager, has changed his business connections, and has become associated with the engineering firm of J. A. Grant & Company, of Boston, whom he will represent in the West. Mr. Glasier has taken offices at 103 Adams street (Electric Club building) Chicago, J. A. Grant & Company are a young but vigorous concern which has made an enviable record for itself. The firm does general engineering with the McIntosh and Seymour engine as a leading specialty. Mr. Glasier has a host of acquaintances in the electrical business, all of whom will unhesitateingly predict him entire success in his new venture.

The National Carbon company of Cleveland, O., has issued the following circular: "It gives us great pleasure to state that we have finished rebuilding the portion of our factory destroyed by fire two months ago, and are now running at our full capacity in every department. We have spared no expense in erecting special machinery of our own design, and believe our facilities to be far in advance of any other carbon factory. We wish to present our acknowledgments to our patrons for their kindness in overlooking the unavoidable delays in the matter of shipments of carbons, and to say that as we are now running full again, we are able to serve every one promptly as heretofore. We feel that we can best show our appreciation of our patrons' kindness to us during our time of trial by fire by an improvement in the quality of our carbons, and confidently believe that such improvement will be found in the National carbons which you will receive in the future."

Electrical Patents.

Issued Jan. 14, 1890.

419,186. Hood for Electric Lamps. Daniel A. Culman, Jr., Kansas City, Mo.

The second claim reads as follows:

"In a hood or screen for lamps, the screen-sections covered with netting, spring-hinges for holding said sections normally open, and means for fastening the same in a closed position, in combination with a clamping ring."

419,215. Electric Motor. Stanley C. C. Currie, Philadelphia, Pa.

Multiple field poles are employed, and the changes of polarity in the poles of the armature are caused to pass from + to neutral and then to —, and vice versa.

The fourth claim follows:

"In an electric motor, the combination with the field magnets of the multipolar armature, the poles of which are each independently wound in different circuits, and the commutator with the bars of which the armature circuits are connected.

419,264. Method of Making Electrolytic Meters. Arthur E. Kennelly, Orange, N. J.

The process consists in heating both the solution and the electrodes to expel the oxygen therefrom.

419,282. Electric Steam Generator. Jeremiah O'Meara, New York, N. Y.

Claim four reads:

"In a heating apparatus, a refractory crucible adapted to be highly heated, combined with a heating agent applied to the said crucible and adapted to heat the same, and a vessel within the crucible to contain water to be heated or converted into steam and separated from the crucible by means of an alloy fusible at a predetermined high temperature."

419,308. Conduit for Electric Railways. Bernard J. Black, Richmond, Va.

419,309. Electric Street Railway. Bernard J. Black and Wilton F. Jenkins, Richmond, Va.

419,312. Dräft-Annunciator for Mines. William Bulluck, Centralia, Pa.

419,313. Electric Railroad Telegraph. Baylus Cade, Louisburg, N. C.

419,314. Electric Railroad, Baylus Cade, Louisburg, N. C.

419,355. Railway Car. Albert B. Pullman, Chicago, Ill.

419,365. Electric Connector. John A. Seely, Brooklyn, N. Y.

The invention is applicable, principally, to lead-covered cables which are usually laid in conduits through the streets, the joints being made at intervals where lateral branches are run off to buildings.

The last claim reads:

"5. A coupling or joint for electrical conductors consisting of a tube or sleeve, in combination with a conductor, the tube being provided with a longitudinal slit, and solder filling in the slit and connecting the walls of the two with the conductor."

419,367. Meter for Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

Of the twelve claims we give the eighth:

"In an electric meter having a rotating armature, a polarizing conductor for the armature, and a second polarizing conductor placed at an angle to the first and consisting of continuous rings of conducting material placed side by side."

419,487. Electric Cut-out. John F. Wollensak, Chicago, Ill.

The object of the invention is to provide a compact and substantial device for connecting and disconnecting the wire in an electric circuit.

The claim reads:

"In an electric cut-off, the combination of a bracket, an insulating piece arranged in the bracket, a binding screw arranged in the insulating piece and exposed in one portion, and a thumb-screw that may be turned into the bracket until it connects with the exposed portion of the binding screw, and out until it disconnects therefrom."

419,524. Shade for Incandescent Electric Lights. Joseph H. Huber, Greensburg, Pa.

419,588. Electric Railway. Isidor Kitsee, Cincinnati, Ohio.

419,617. Socket for Incandescent Lamps. Charles H. Lawton, New York, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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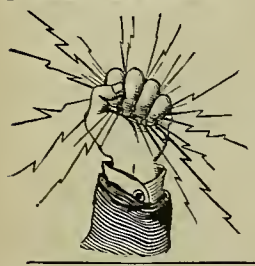

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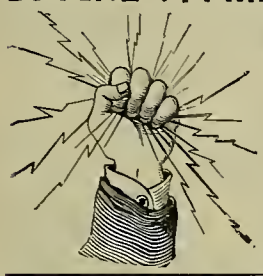

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The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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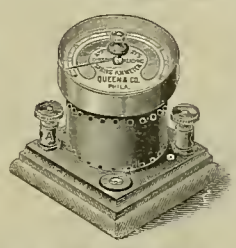

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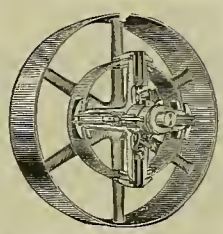

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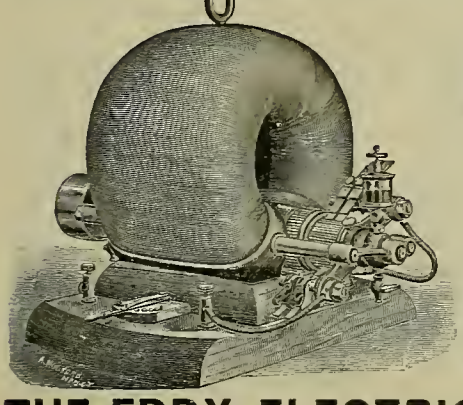

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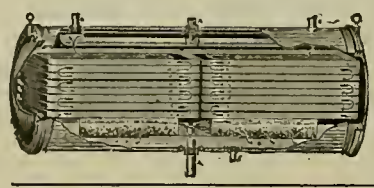

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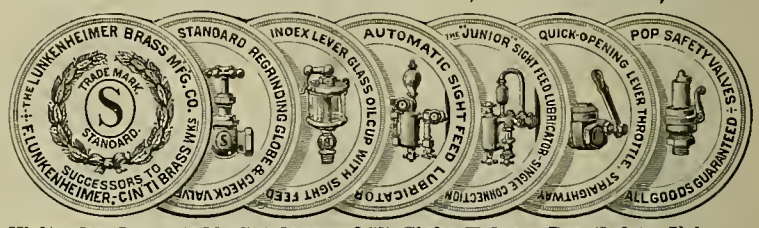

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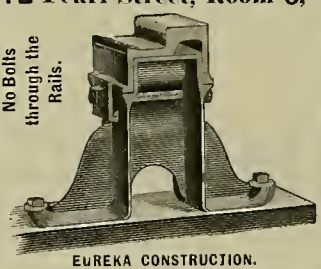

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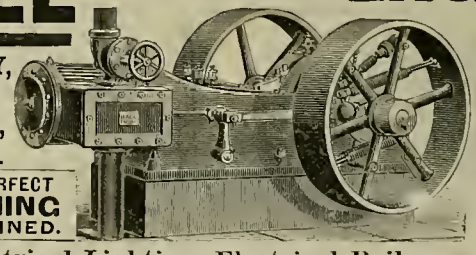

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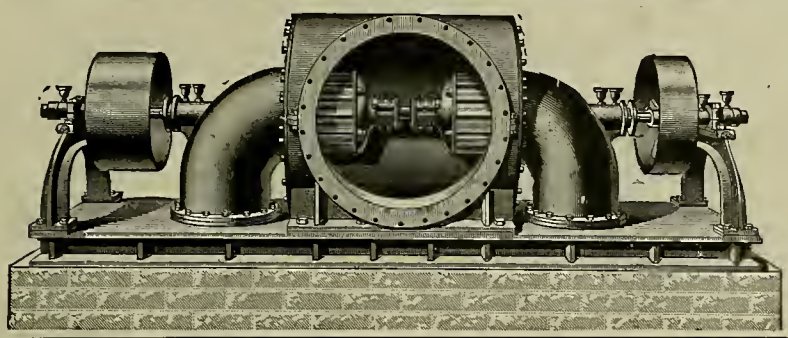

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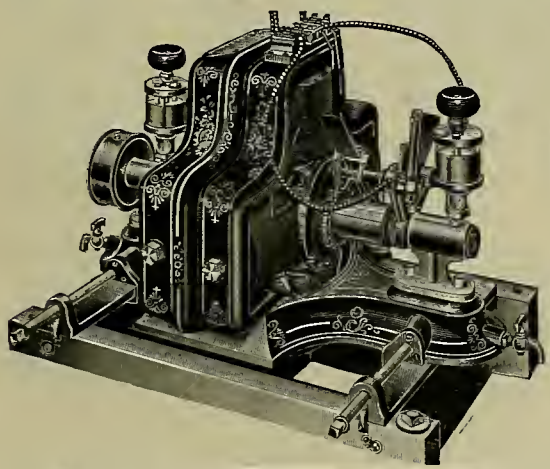

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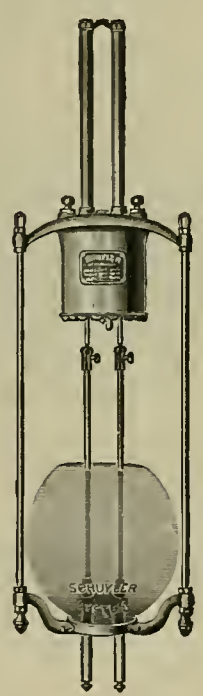

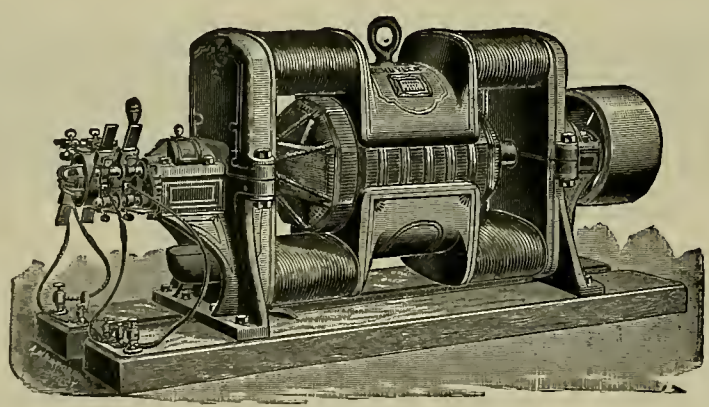

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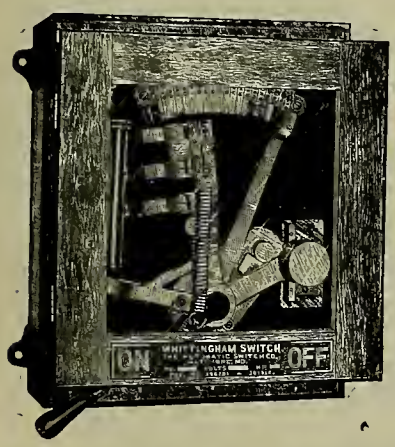

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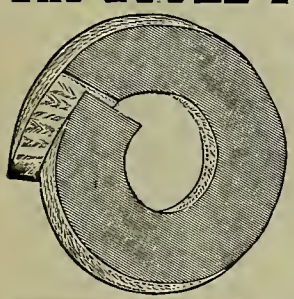

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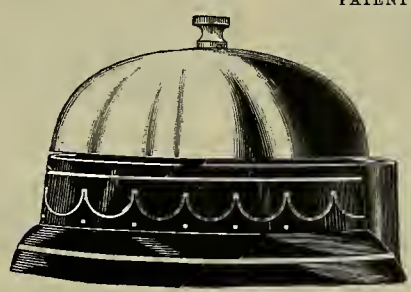

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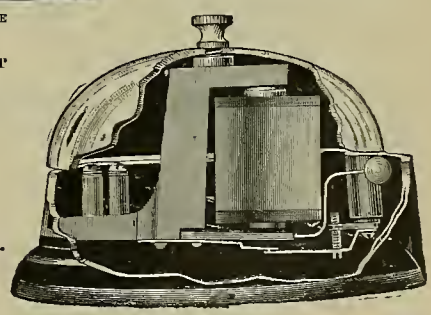

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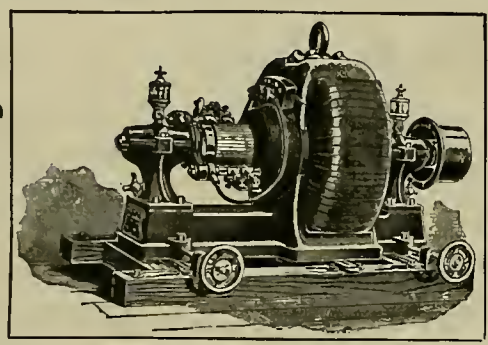

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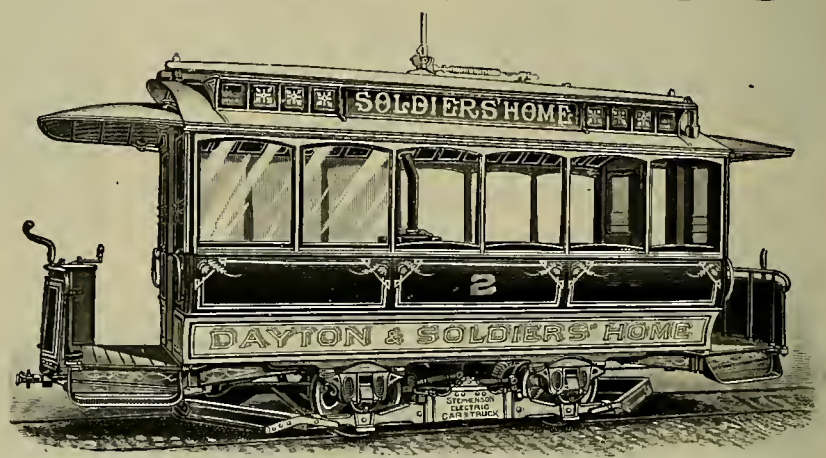

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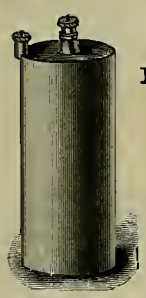

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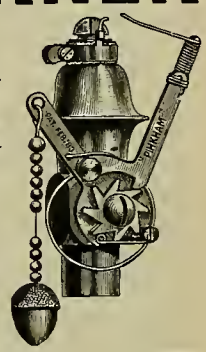

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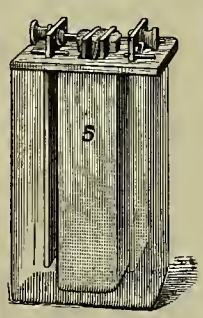

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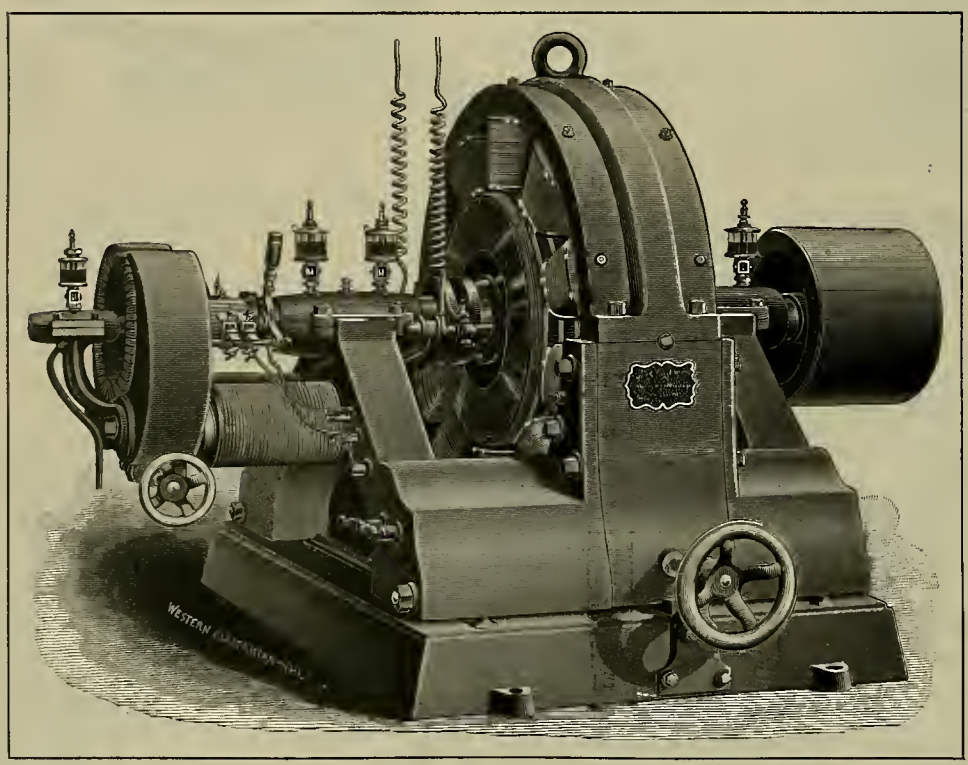

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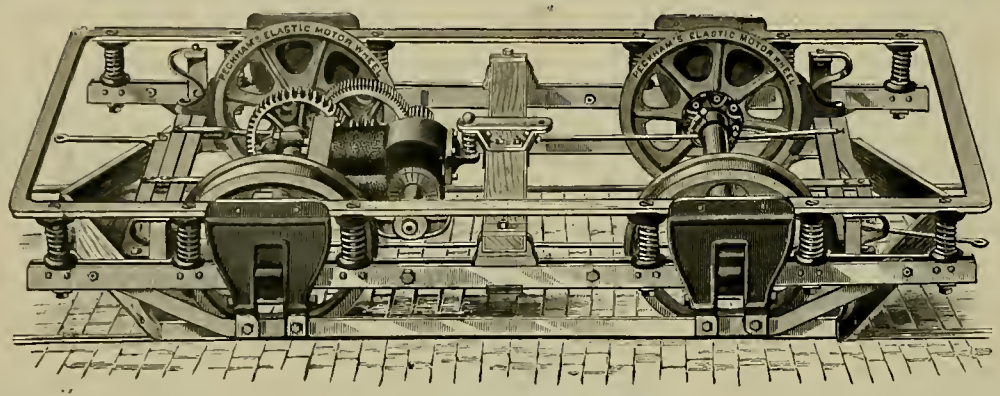

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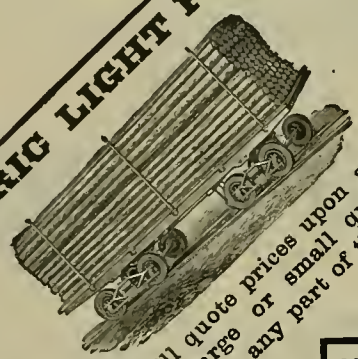

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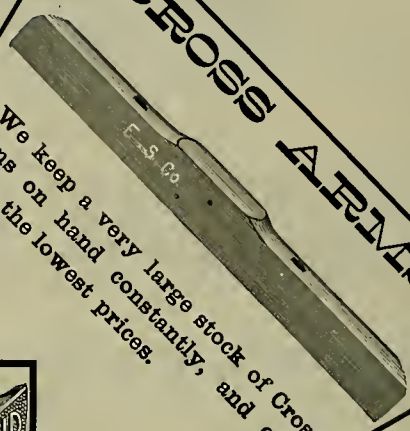

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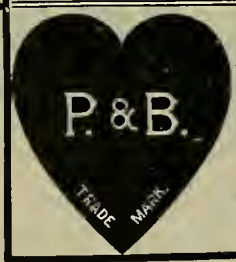

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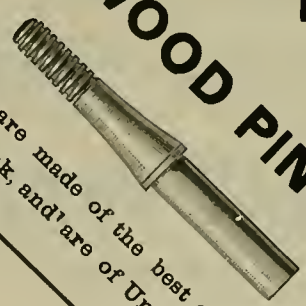

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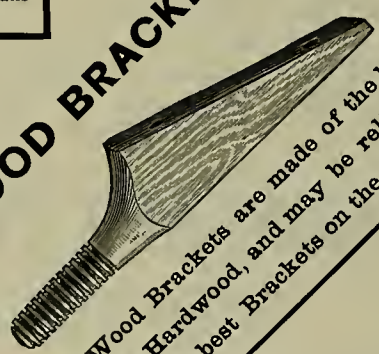

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2 *That the Brush Patent in suit is the Pioneer Patent for Double Carbon Arc Lamps.*

3 *That the Patent is Broad and Fundamental.*

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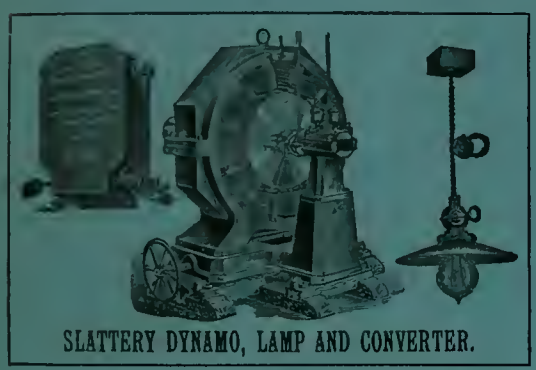

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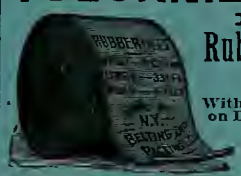

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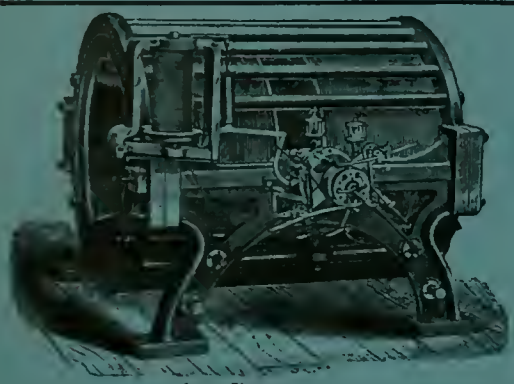
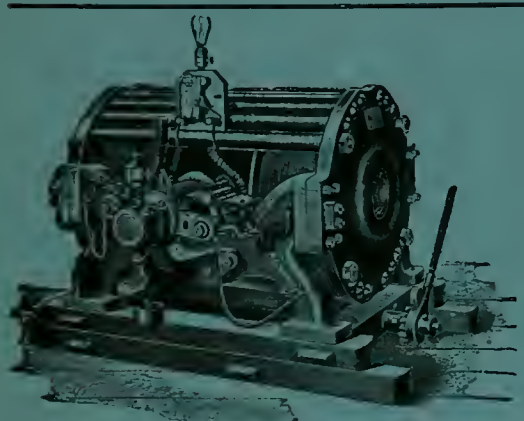


Arc Dynamo.

No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent., are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.



Direct Current Incandescent Dynamo.

Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.

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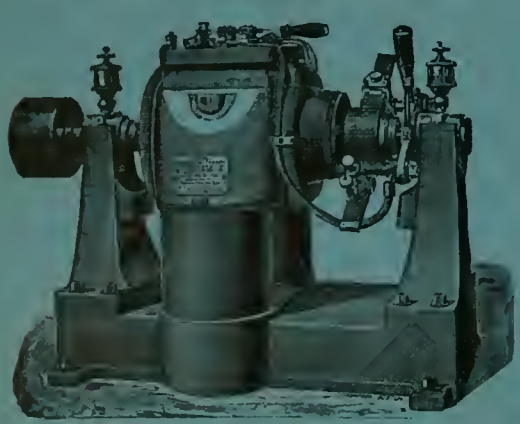
The problem of long distance incandescent lighting is practically solved by the alternating current dynamo, and to meet the demand for a machine of this character we have constructed what is unquestionably the most perfect alternator offered the public to-day, embracing as it does, all the features that combine to make a perfect dynamo—automatic regulation, perfect mechanical construction, highest efficiency, and economy of operation.



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The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

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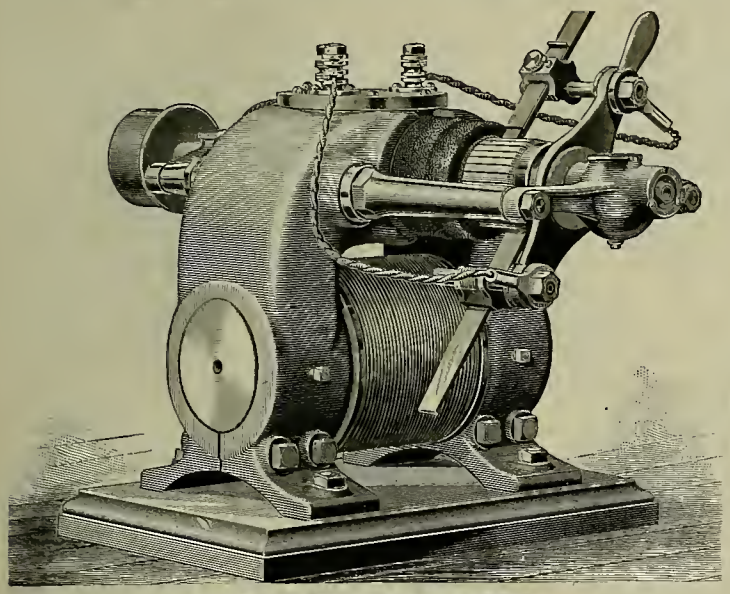

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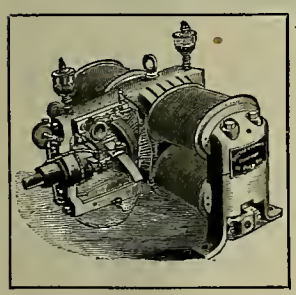

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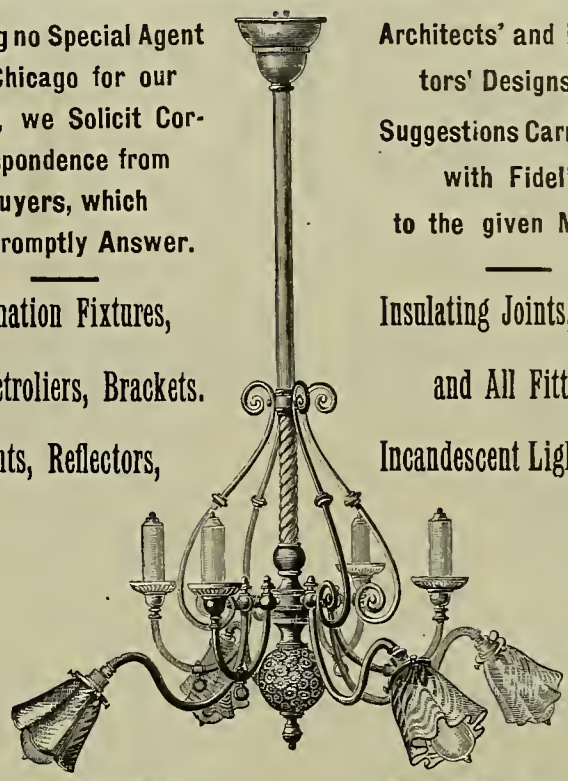

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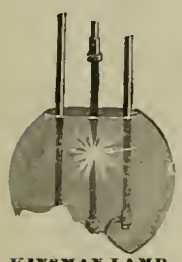

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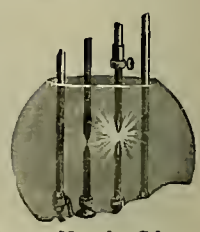

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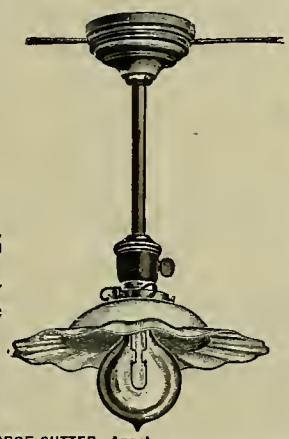

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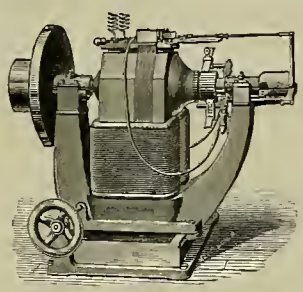

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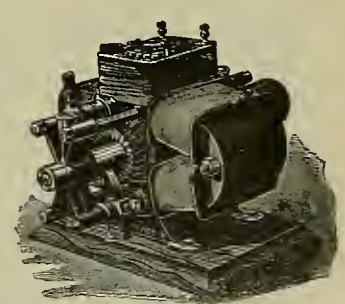

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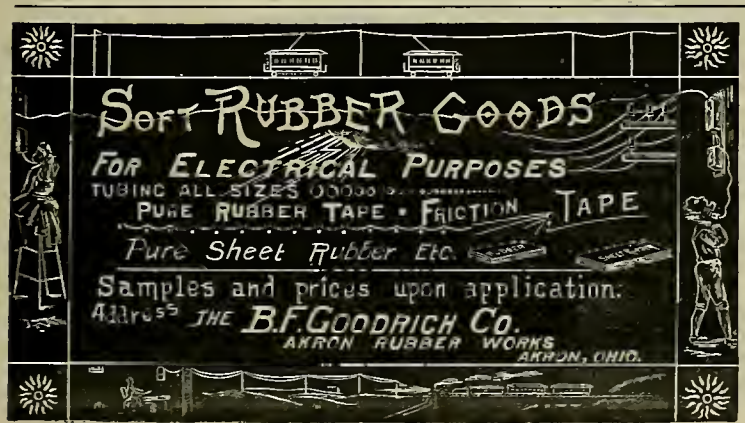

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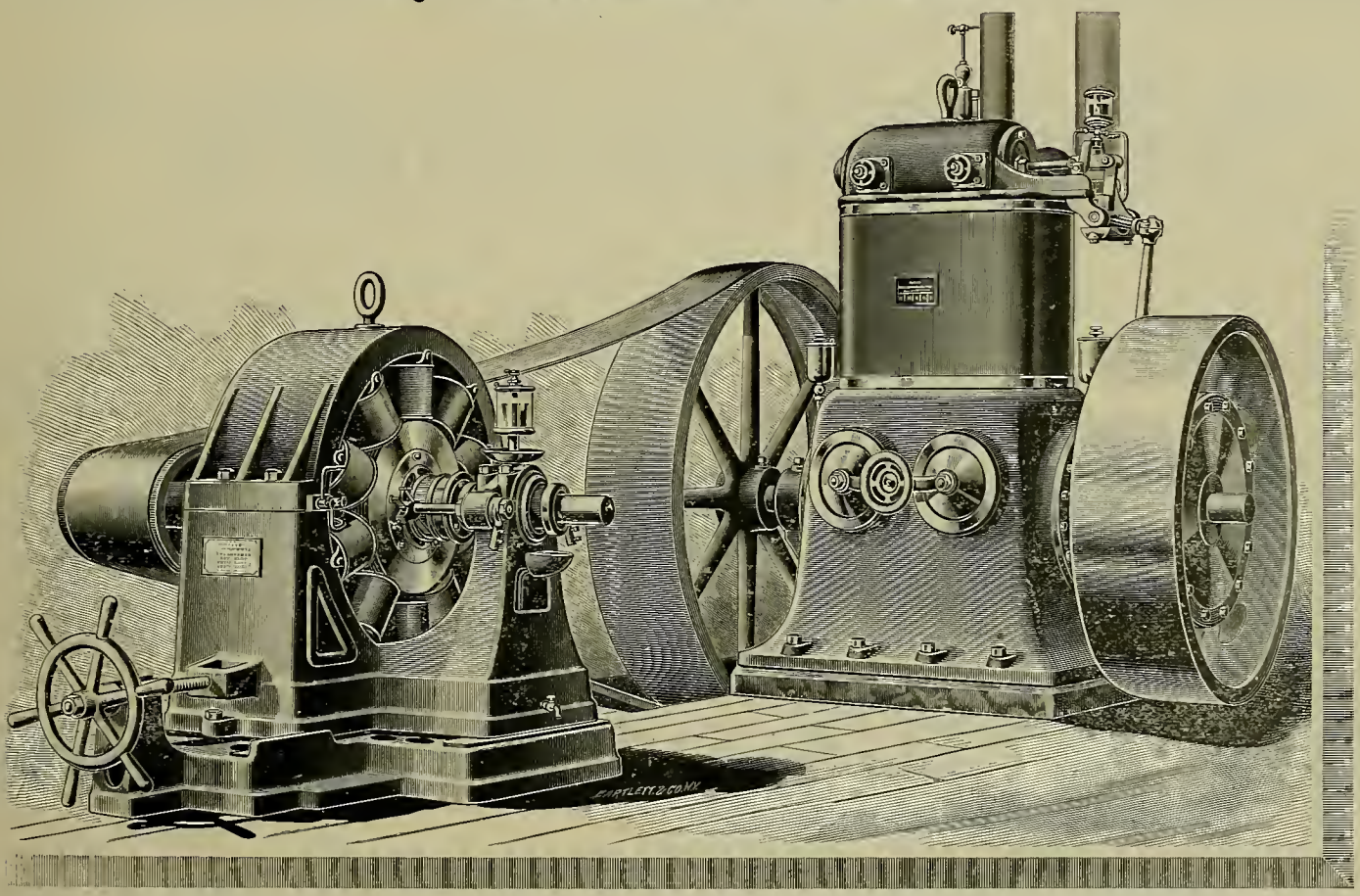

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Western Electrician

EVERY SATURDAY.

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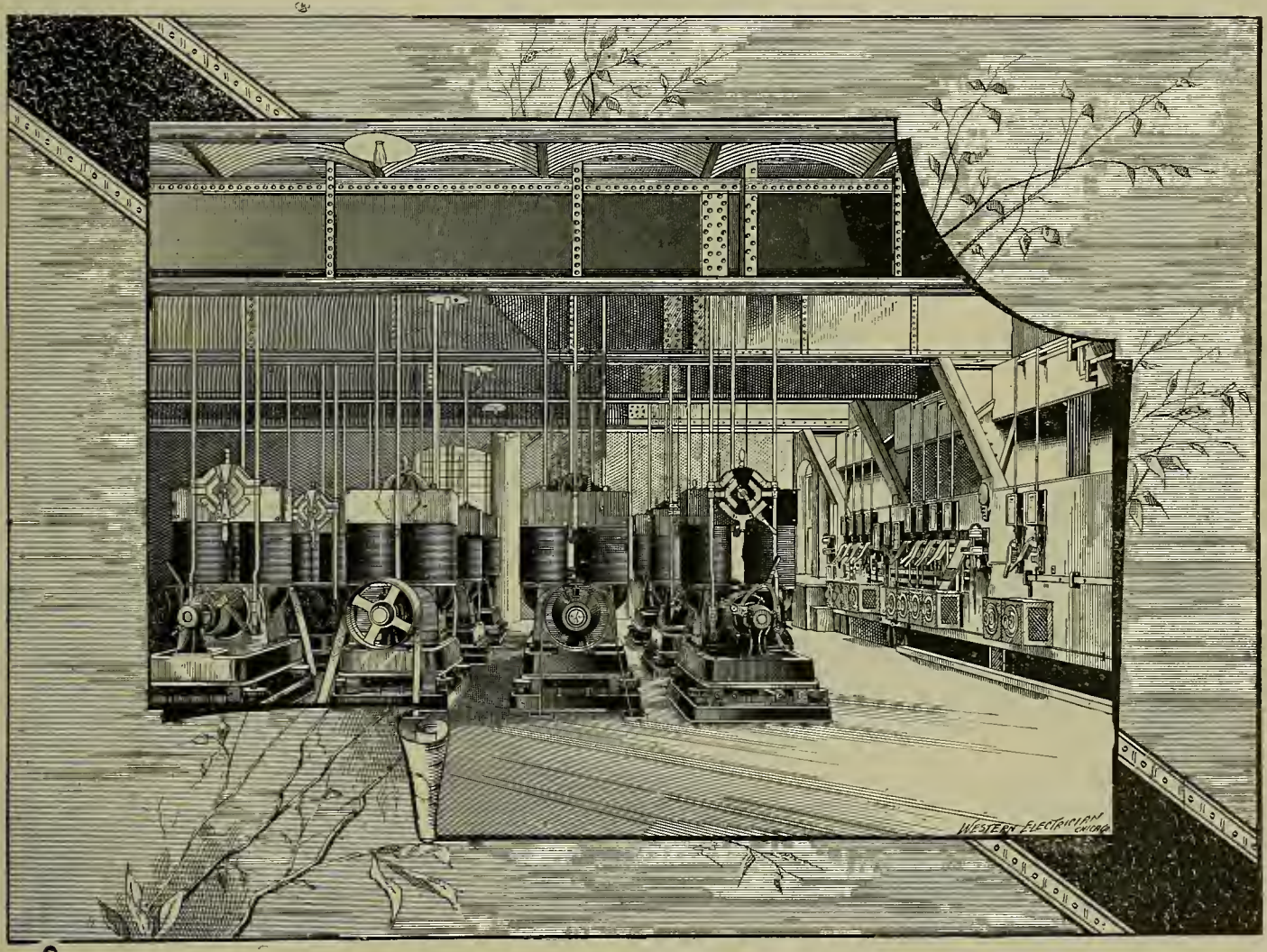
MASSACHUSETTS INSTITUTE OF TECHNOLOGY DEPARTMENT

Dynamo Room in the Chicago Edison Company's Station.

The cut presented herewith illustrates the general arrangement of the machines and conductors in the dynamo room of the Chicago Edison station.

The plant was started August, 1888, with eight 1,300 light Edison machines driven in pairs by four Armington & Sims engines of 200 horse power each. In November, 1889, four new 1,300 light dynamos were added to the plant, together with two Ideal 200-horse power engines. The steam generating plant consists of four Heine safety boilers. These are located in a room on the ground floor just in the rear of the engine room.

The dynamo room is situated over the engine room, and each engine belts directly to two machines. The dynamos are set on bases which can be raised or lowered by means of screws, each operated by a worm and gear. This construction, which is indicated in the cut, admits of perfect adjustment of belt tension with a small expenditure of labor. A special feature of the dynamo room, and one of considerable importance, is that its floor is so constructed as to have no connection whatever with the walls of the building. The weight of the entire machinery and the floor itself is supported on a number of massive iron pillars. By this arrangement the transmission of vibration throughout the building is prevented. The room as now arranged, contains the twelve large Edison machines. There is, however, still space enough for 24 additional machines. The Edison three-wire system is used throughout. From the dynamo room 34 feeders run to different sections of the city. Each feeder has its own ampere meter, and is numbered and lettered in accordance with the street intersection at which it terminates. Each dynamo also has its own ampere meter, indicating constantly the current it is generating. Two large ampere meters of special design are used to indicate at all times the total load on the entire system. Every feeder has a pressure indicator which shows at any moment the electrical pressure at its terminus. A cleaver or knife switch of special design is in circuit with every feeder. The entire system is underground, and is fed from the one station. The Edison underground system of tubing is used throughout. The conductors of the underground system have a total length of about forty-eight miles and are calculated for a maximum load of 50,000 lamps. Up to the present time the Chicago Edison company has finished the wiring for 25,000 lamps, and is supplying current to motors, having a capacity of about 275-horse power. Besides operating the central station the company, under the management of F. S. Gorton, has done a considerable amount of outside construction, installing engines and dynamos for isolated and central stations. In addition the company proposes to extend still further its present system. In a recent conversation Mr. Gorton said: "The company is now preparing plans to cover the South Side district as far out as Thirty-fifth street. We do not know just where we will locate the new station, but we are considering the advisability of connecting it electrically with our Adams street plant. This would, of course, necessitate a considerable outlay for copper but we feel that the plan is well worth our careful consideration. You see," continued he, "by having the stations so connected the Adams street station could take care of the load of the new station after midnight. This load, you know, will be very light indeed after 12 o'clock."



DYNAMO ROOM OF THE CHICAGO EDISON COMPANY'S STATION.

The 800 light Edison plant in the Oliver Chilled Plow works, at South Bend, Ind., is working to the satisfaction of all concerned. The Leonard & Izard company of Chicago installed the plant.

New York Electric Lighting Interests Combined.

It is reported that the New York electric lighting companies have combined their interests, the Westinghouse company predominating in the new concern. The Edison interests are not in the combination, but the Subway company has passed under its control. In connection with the publication of this consolidation, it is reported that the consolidated companies propose to re-organize the city into small districts, depending upon various stations, so that the lighting will be so managed that no station will be required to furnish a circuit for territory beyond its proper capacity. Under the reorganization system it is proposed to light the whole city from seven stations, one on Washington street near Cortlandt, one on Vandam street near Canal, one on Elizabeth street near Prince, one at Twenty-fourth street and North River, one at East River and Twenty-eighth street, one at Eightieth street and East River, and the Mount Morris station in Harlem.

Western Electric Company's High Tension Dynamo.

The accompanying cut illustrates the latest form of high tension arc light dynamo of the Western Electric company of Chicago. The capacity of these machines ranges from 10 to 60 lamps. The machine is of compact form, is mounted on a strong, sliding carriage which holds it firm and steady, and is adjustable for tightening the belt if necessary, while running.

The machine has a specially constructed drum armature, the few parts of which are easily accessible. From the method of winding the armature, it is claimed, highly economical results, with any number of lights, are obtained, destructive or damaging heat is avoided under all circumstances. By a simple movement of the brushes backward or forward, any number of lamps, up to the capacity of the machine, may be run without undue sparking at the commutator.

The field magnets are constructed with a view to securing a seat for bearings and pole plates at the same time. The bearings are plain, and the entire design is so simple that the machine can be put together without difficulty.

Asheville, N. C., will be illuminated by electric light, but whether a contract with a local company will be made, or a city plant be installed, has not yet been determined.

The Barnesville, Ga., Manufacturing company will put in an extensive electric light plant in the spring.

New Induction Coil and Battery.

The accompanying cut illustrates an ingenious combination of an induction coil, a galvanic battery, and electrodes. The object of the invention is to combine the essential parts in the smallest possible compass. The apparatus was designed with this object, and also with a view to the difficulties of protecting the coil and its accessories from the battery solution, which is liable to escape from its cell, and of securing good and lasting contacts. The coil and battery are contained in a cylindrical case, which is composed of hard rubber at the ends and of

NEW INDUCTION COIL AND BATTERY.

metal in the middle, at least on its outer surface. The bottom or lower end of the cylinder is composed of a hard-rubber receptacle closed by a screw-cap. Within this is placed the cell; in the central or metallic portion of the cylinder is mounted the induction coil. The automatic circuit-breaker is arranged as shown just above it. The upper end of the cylinder is provided with a metal screw-cap, to which one electrode, T, is secured, and the current from the other terminal of the coil is conveyed by a switch to the metal surface of the cylinder, which is held in the hand. The battery cell is composed of carbon, enameled or varnished on its exterior. It is provided with a perforated carbon top cemented to the main cup, and in the perforation a rubber stopper carrying a zinc electrode, is fitted. The cell is held in position by a spring-seat, and when in position the terminals of the primary coil engage with the carbon cell and a metal pin that holds the zinc, respectively.

The electrical connections and operations of this device will be readily understood. The ends of the secondary coil are led to the electrode, T, and the cap, so that any one holding the instrument and applying the electrode to any desired part of the body will receive a current by pushing up the contact-making slide until the part in contact with the hand is brought into connection with the secondary coil.

The apparatus is the invention of L. T. Stanley and is handled by the Stanley Electric company of Philadelphia, Pa.

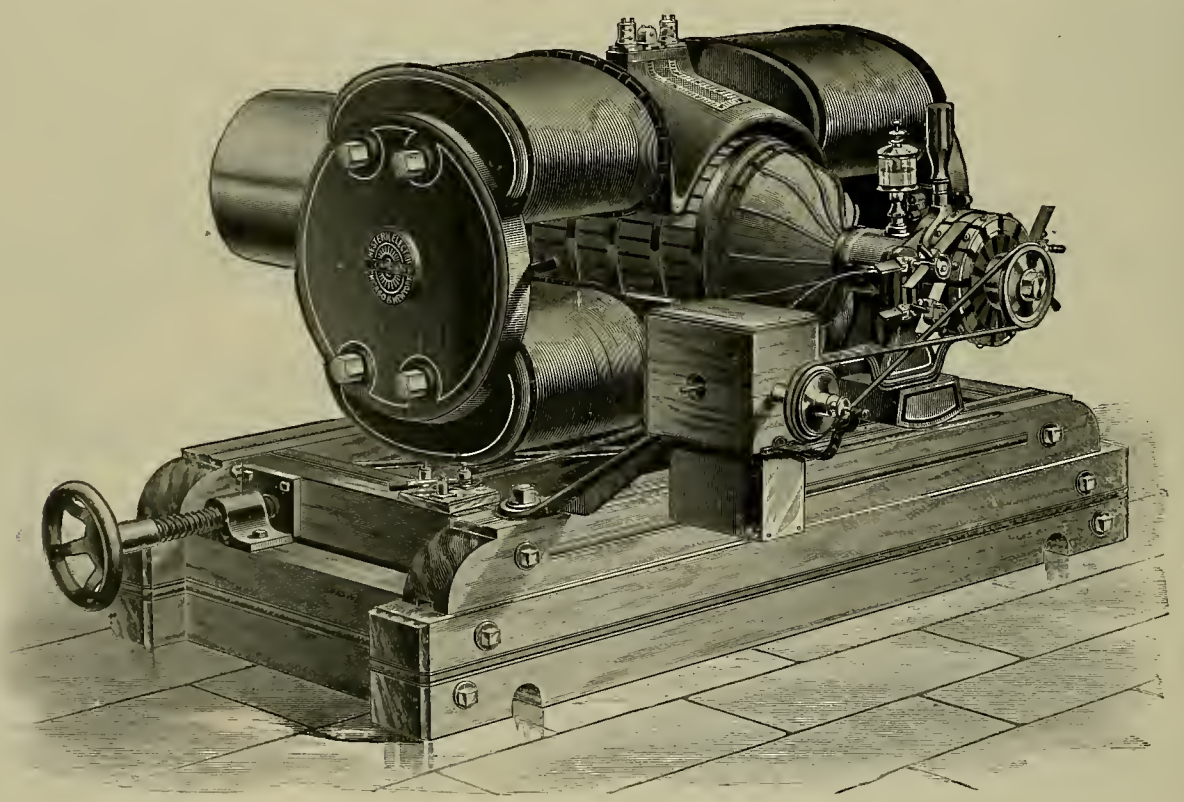
The East End Railway company of Memphis, Tenn. has decided to enter the electric lighting field, and will install an arc and incandescent plant.

Kansas City Convention of the National Electric Light Association.

The arrangements for the convention of the National Electric Light association at Kansas City, February 11, 12, 13 and 14, are almost completed. The Special "Electric Limited" train which will leave Chicago at five o'clock February 10th, will reach Kansas City early Tuesday morning. The guests will make their headquarters at the Coates House. A number of delegates will register at the Midland and Centropolis. The rooms of the officers of the association will be on the second floor of the Coates House. The fact that there will be a large attendance has been shown by the demand for rooms at the hotels. The session of the convention will be held in the Coates opera house, which is located within a few steps of the hotel. The opera house is a pleasant hall, and is conveniently arranged. The Casino in which the electrical exhibits will be located, is situated in the same block. The hall with its gallery, has an area of 6,000 square feet. The work of putting the exhibits in place will be begun February 9th, by the transfer company which has the matter in charge. The electric light companies in Kansas City have agreed to furnish the necessary current. President Weeks has made arrangements by which exhibitors can secure the services of all the workmen they require to arrange exhibits. Should it be found that the Casino hall does not afford room enough for exhibits, Music hall will be utilized as an annex; so in any event ample accommodations will be provided for all who wish to make exhibits.

The committees which have in charge the reception and entertainment of guests, promise the delegates a thoroughly enjoyable stay in Kansas City. They are hard at work but their plans are not yet perfected.

In a recent conversation President Weeks said to a representative of the WESTERN ELECTRICIAN at Kansas City: "I have recently heard from all the gentlemen who have promised to read papers at the convention. They all assure me that they will be present except Prof. Thomson. He has been in ill health lately and possibly may not be able to attend the meeting. But he writes that he will make a great effort to be present. The prospect is that we will have a large attendance and a very interesting convention in every way. The exhibits, of which there will be a large number, will be of interesting character. We are receiving applications for space in every mail. The electric compa-



WESTERN ELECTRIC COMPANY'S HIGH TENSION DYNAMO.

nies have all co-operated enthusiastically in making arrangements for the convention."

The following companies will make exhibits at the convention: Edison Machine Works; Sprague Electric Railway & Motor company; Eddy Electric Motor company; C & C Electric Motor company; National Electric Manufacturing company; Gate City Electric company; Okonite company; National Carbon company; Standard Carbon company; Charles D. Jenney & Co.; Charles A. Schieren & Co.; Royal Silk Manufacturing company; James W. Queen & Co.; Phoenix Glass company; Ansonia Brass & Copper company; Detroit Motor company; Weston Instrument company; American Electrical Works; Palermo Mica company. This list comprises all the companies which have decided positively to make exhibits. The list will doubtless be materially increased in the next few days. The Edison Machine Works and the Sprague Electric Railway & Motor company's display, will occupy 500 square feet and will constitute in all probability, the largest exhibit in the hall.

Electrical Method of Finding the Position of Distant Objects.

The accompanying cut illustrates a method by which a gun may be directed upon a target when its distance from the piece is not known to the gunner, or in fact, when the individual at the gun is unable to see the target by reason of fog or smoke or other causes.

The method is the invention of Lieut. Bradley A. Fiske of the United States navy. In the plan here described, observers stationed at points distant from the gun itself—but which command a good view of the area within the range of the gun—are enabled to discover the bearing and range of a target and communicate it to the gunner.

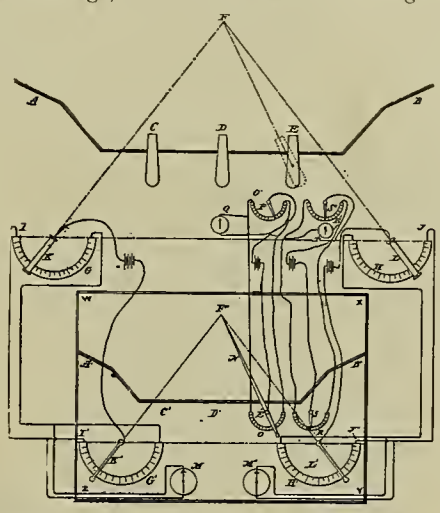
The method may be better understood by referring to the diagram. In this *A B* represents a line of the parapet of a fort or other defensive work. *C*, *D*, and *E* are guns located in the fort and commanding the area which includes the position of the target *F*. Now, the object to be attained, is to lay all of the guns *C*, *D*, and *E* correctly upon the target, although the gunners may be unable to see it and be ignorant of its bearing and distance.

In the description which follows the operations connected with one gun only will be referred to. In the diagram *G* and *H* are two arcs of conducting material placed symmetrically with respect to a base line *I J*. These arcs are located at stations distant from the positions of the guns, and so situated that a view of the area to be protected by the guns will not be cut off from the stations by smoke or other obstacles. For this reason it is better that elevated positions should be chosen.

K and *L* are two pivoted telescopes, the free ends of which move over the arcs *G* and *H*, and constantly maintain electrical contact with them. These telescopes may be directed upon the target *F*, which will therefore be at the intersection of the two lines of sight of the telescopes.

Located at a station distant both from the guns and from the positions of the arcs *G H*, and say at a place safe from the effects of the enemy's fire, another station is established. This for convenience is called a "directing station," in which is a chart or map, represented by the rectangles *W*, *X*, *Y*, *Z*. On this chart the line *A' B'* represents the line *A B* of the parapet of the fort, and the points *C' D' E'* correspond to the centers above which the guns *C D E* are laterally turned. The chart represents the area within the range of the guns on some definite reduced scale, so that distances taken on it represent actual distances. On this chart is drawn a line *I' J'* corresponding to the base line *I J*, and symmetrically disposed with reference to this base line are arcs of conducting material *G'* and *H'*.

K' and *L'* are pivoted arms similar to the arms *K* and *L*. The free ends of these pass over and make constant contact with the arcs *G'* and *H'*. Arc *G'* is similar in form and in electrical resistance per unit length to the arc *G*, and the arc *H'* is likewise similar in the same particular to the arc *H*. Extending from the extremities of the arc *G* to the extremities of the arc *G'* are two wires, and extending from the pivoted telescope *K* to the pivoted arm *K'* is a wire, which includes a battery. Connected in loop from the two wires is a galvanometer *M*. It will now be evident that the wires referred to, the arcs *G G'*, the battery, and the galvanometer *M* are connected in circuit in the form of a Wheatstone bridge, and that the effect of moving the



ELECTRICAL METHOD OF FINDING THE POSITION OF DISTANT OBJECTS.

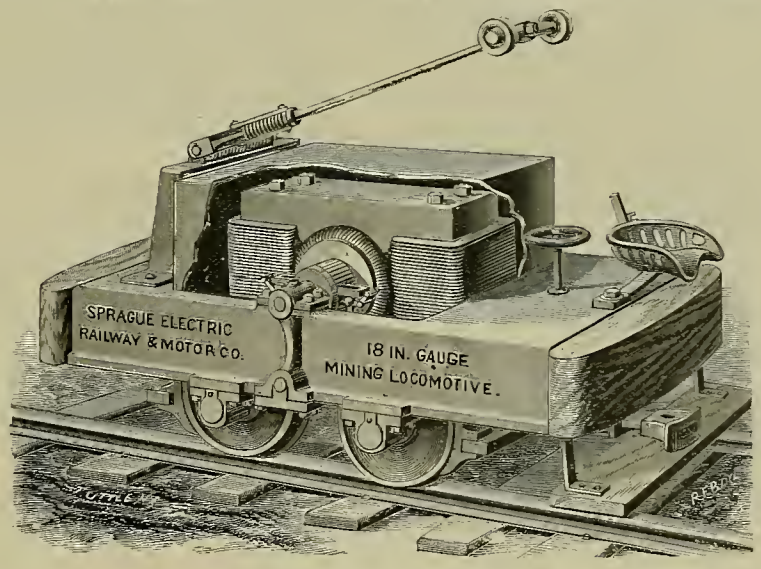
telescope *K*, for example, to the right on arc G is to increase the resistance in the one member of the bridge and decrease it in the other member, and that the same is true of a similar movement of the arm *K'* over the arc *G'*. Therefore, if the telescope *K* be set at a certain position on the arc *G*, it is simply necessary to set the arm *K'* to such a position on the arc *G'* as that the galvanometer *M* shall show no deflection, when the bridge will of course balance, and therefore the angle made by the arm *K'* to the base line *I' J'* will be equal to the angle made by the telescope *K* to the base line *I J*. Now, as the arrangement of the two arcs *H H'* and the current connections is the same as that of the arcs *G G'* and their associated parts, it follows, therefore, that if the two telescopes *K* and *L* be sighted upon the target *F*, and if a third observer moves the arms *K' L'*, and at the same time watches the galvanometers, he will have placed the arms, when both galvanometers show zero reading, at precisely the same angles as the telescopes *K L*. It will now be evident that as the chart bears a definite proportion to the area, including the position of the target, the axes of the arms *K' L'*, if they be prolonged, will intersect at *F'*. This point would, therefore, represent on the chart the actual position of the target *F*. Upon the chart there are pivoted three pointers. Only one of them, however, is shown at *N*. These pointers are pivoted at *C'*, *D'* and *E'*, which points, as already stated, correspond to the centers of horizontal motion of the guns *C*, *D* and *E*.

Consequently, if the pointer *N* be turned on its pivot it will correspond to the positions of the gun *E* when it is turned on its pivot. One arm of the pointer *N* is long enough to sweep over the area which includes the target, and the other arm makes electrical contact with an arc *O*, of conducting material. At the gun *E* is arranged a similar arc of conducting material *O'*, and sweeping over this arc is the arm *P*. The extremities of arc *O'* and *O* are connected as shown. It will now be apparent that these arcs, the galvanometer *Q*, and the battery are here connected in a Wheatstone bridge in precisely the same manner as are the arcs *G G'*. It follows therefore, that if an observer at the chart brings the arm *N* upon the point *F'*, which is the intersection of lines drawn from the arms *K' L'*, he will have established the angle at which the gun *E* must be laid with reference to the base line *I J* in order that it may point in the direction of the target *F*. At the same time, by the movement of arm *N* over the arc *O*, the observer throws into the circuit a fractional portion of the arc having a resistance proportionate to the angle, and hence, in order to interpose an equal resistance in the bridge, the person in charge of the gun over which is located the arc *O'*, must move the arm *P* over a similar angle. He knows that he has moved it over this similar angle by the galvanometer *Q* reading zero. He has, therefore, simply to read the angle from the arc *O'* and lay the gun at the same angle.

While the above method has been described as applied to the training of a gun upon the target, it will now be readily understood that the adjustment for range may be made in a similar manner. Lieut. Fiske's invention is shortly to be put into service on the new cruiser Baltimore.

Electric Locomotive for Metal Mines.

An electric locomotive for mines is shown in the accompanying cut. It is simple, powerful and compact, and is built with special reference to the arduous duties required of such a machine. The locomotive shown in the engraving is constructed for a gauge of eighteen inches, but it can be accommodated to any gauge in ordinary commercial work. In order to protect the machine from damage, all the working parts are completely boxed in. The speed of the



ELECTRIC LOCOMOTIVE FOR METAL MINES.

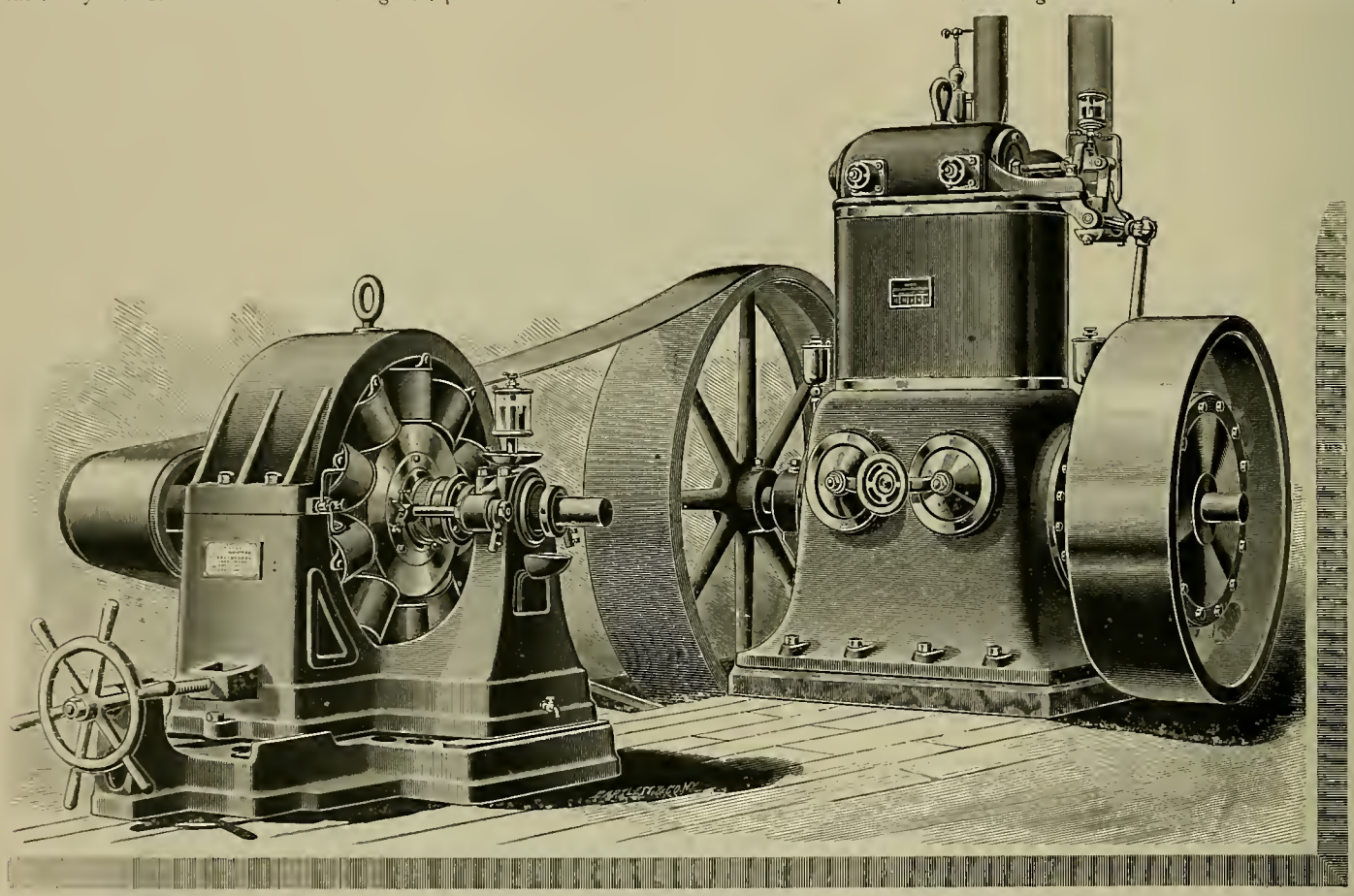
motor is controlled by a switch which throws down the winding of the field into different electrical combinations, thus varying the speed of the motor without the use of wasteful resistance. The direction of rotation is also governed by the same switch. The operation of the motor is simple, and the machine can be easily handled by an ordinary workman.

Any system of conveying the current from the dynamo to the locomotive can be used, either using the rails as one side of the circuit for the return of the circuit, or employing a complete metallic circuit by the use of a double overhead trolley wire. In this latter case, a trolley pole shown in the view, carrying at its upper end two trolley wheels for making running contact with

the overhead wires, is attached on the rear of the locomotive car. The locomotive is now being manufactured by the Sprague Electric Railway & Motor company, from designs made by I. E. Storey.

Westinghouse Compound Engine and Alternator.

The cut presented herewith illustrates a Westinghouse compound engine belted to a Westinghouse alternating dynamo. The cut shows the engine in front view. The dynamo has already been described in the WESTERN ELECTRICIAN. This type of engine resembles in general form the Westinghouse "junior" automatic engine. In this new compound engine, however, the area of one cylinder is enlarged $3\frac{1}{2}$ times that of the other. The valve chest lies across the top of the cylinders as shown. It is cast in one piece, the various steam passages being chambered in it. The valve chest also contains a small valve by which live steam can be admitted to the low pressure cylinder. By the use of this valve the engine



WESTINGHOUSE COMPOUND ENGINE AND ALTERNATOR.

may be turned "off center" when starting. The main valve in cylindrical, and is actuated by a single eccentric controlled by a governor carried in the fly-wheel. The use of a single valve and eccentric is a feature in this engine. As all the parts of the governor except the eccentric are inclosed in a case which, at the start, is filled with oil, it requires no attention for a considerable time. The lubrication of the pin connections and eccentric is automatically performed through feed pipes, which are supplied from sight feed cups. The cranks are lubricated the same way as those in the automatic engine. These compound engines are designed to be run at high speed, the piston velocity ranging from 333 feet per minute in engines with a stroke of 6 inches, to 700 for a stroke of 20 inches. The sizes range from 5 to 500 horse power.

Electricity in the Census.

Allen R. Foote reports that his preliminary work in the census department, which has brought him in contact with managers of central stations and electrical manufacturing companies throughout the country, has shown him that all who are interested in the development of electricity fully appreciate the necessity for the work which has been assigned him. His time has been necessarily limited, and for the present he has found it necessary to make comparatively short visits, at even the most important points. He is much gratified, however, at the earnest assurances of co-operation he has received from all whom he has seen.

The Overhead Wire Controversy in Chicago.

City officials and electric light companies in Chicago have been exchanging views of late on the question of overhead wires in Chicago. It will be remembered that several companies were organized in Hyde Park, South Chicago, Lake View and the Town of Lake, for commercial lighting just before these suburbs were annexed to Chicago. The authorities of these places granted the companies franchises to operate electric lighting plants in their respective districts and to erect and maintain poles and wires. Before the companies could establish their plants the local boards of these suburbs passed out of existence, and when it became necessary to secure permits for the establishment of their circuits the companies applied to the commissioner of public works of Chicago for the necessary authority. These permits were referred to City Electrician Barrett for his inspection and indorsement. It is scarcely necessary to say that he did not favor the proposition; on the contrary he flatly refused to sanction the proceeding, though he was advised by the law department that under the annexation law, the commissioner of public works would be obliged to grant the application. Prof. Barrett nevertheless persisted in his refusal to indorse the application, and under instructions from the law department the commissioner of public works, issued the desired permits. This did not close the controversy, however. Mayor Cregier learning of the affair decided to take a hand in the controversy, and to support Prof. Barrett. The companies were notified to discontinue operations, and were advised to put their wires underground. The mayor said the police regulations empowered the city to enforce the rule against overhead wires, and he proposed to see that its provisions were complied with. This unlooked for opposition surprised the new companies, and a conference was arranged. Prof. Barrett was unyielding in his opposition to overhead wires. He explained to the representatives of the companies that he could not do otherwise without stultifying himself. He had fought overhead circuits and had succeeded in causing Chicago companies to bury their wires, and he could not consistently follow any other course than that which he had adopted.

A proposition was submitted at the conference providing for the stringing of wires in alleys and over house tops when practicable, and in other cases on the streets. It was agreed that the electric light wires should not be strung on the same side of the street as telephone or telegraph wires, and in crossing streets where there are existing telegraph and telephone lines, the new companies must go under ground. This will probably be accepted.

Electrical Executions.

The commission appointed in New York to inspect the dynamos provided at state prisons for executing murderers has completed its work. The commissioners, while they have not as yet made a formal report, have stated in newspaper interviews their unqualified approval of execution by electricity. A series of experiments conducted by Harold P. Brown, convinced them of the advisability of the substitution of electricity for the halter.

Harold P. Brown, in a recent interview, speaks in this cheerful way of his death-dealing machinery: "I will guarantee now that the time from the moment the prisoner enters the chamber until his death in the chair, will not exceed thirty seconds. We have done away with the helmet, which we first proposed to use. Now we have a head-piece, with a strap running under the chin and over a pad which will rest on the top of the head. This pad will consist of a little brass upright two inches high and an inch square. It will be connected with a flat spiral coil of wire, and above or beneath the wire will be wet sponges. All the three, upright, spiral and sponges, will form one compact cushion, and a band running round the forehead, together with the strap beneath the chin, will keep it in place. For the feet we have prepared a heavy brogan, such as prisoners wear, with a copper insole covered with a sponge. The toe of the

brogan is cut away, and the copper plate projects. The current-bearing wires will fasten to the plate projecting from the shoe and the brass upright on the head. When the prisoner is in his cell the shoe will be slipped on and his arms pinioned. The moment he enters the death chamber he will be put in the chair. Two straps will fasten him in with a snap; the head piece will go on in a twinkling, as there are only two straps to buckle there also; the black mask will be thrown over all and—flash! he will cease to live. We have made experiments with this new apparatus, which has not yet been described anywhere. From the time one man entered the door until the moment the harmless wires were connected with him, took but twenty seconds. We will have any convict ready in thirty seconds."

Electric Meters.

The cuts presented herewith represent several forms of electric meters, the first types of which were exhibited at the Paris exposition. Fig. 1 shows the general design of Blondlot's watt-hour meter. Fig. 2 shows the construction of Clerc's watt-hour meter. Fig. 3 represents the Paccaud-Borel meter. The two watt-hour meters are for continuous current service while the last named apparatus is for alternating work. Blondlot's meter is constructed with two essentially distinct parts—the measuring apparatus and the integrating apparatus. The former of these is an electro-dynamometer whose fixed bobbin with vertical axis is wound with coarse wire and is traversed by the total current furnished to the consumer. The fine wire bobbin placed within the coarse wire one is mounted in derivation between the distribution terminals of each subscriber. The couple exerted upon the movable bobbin by the fixed one is thus proportional to the product, eI, of the intensity, I, of the principal current by the difference of potential, e, at the terminals of distribution. A counterpoise arranged upon an arm mounted upon the axis of the movable bobbin balances the electro-dynamic couple and causes a deflection of this bobbin by an angle proportional to the product, e I. The clockwork movement, an ordinary timepiece, periodically closes (once every five minutes in the case considered) the circuit of a special derivation constituted by two solenoids. The effect of the first of these solenoids is to bring back the fine wire bobbin to zero, and that of the second, which is arranged horizontally, is to render momentarily interdependent the axis of the bobbin and that of a revolution counter which, in every operation, revolves by an angle equal to that made by the movable bobbin before being brought back to zero. The rotations thus given periodically to the revolution counter are totalized, and may be read upon a horizontal dial actuated by an endless screw mounted upon the first axis of the revolution counter.

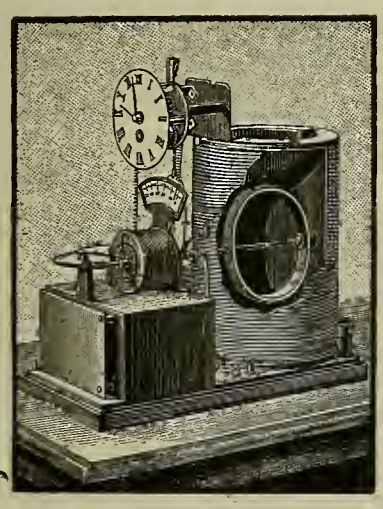


FIG. 1. ELECTRIC METER.

The movable bobbin, in passing over a vertical dial placed beneath the clock, makes known the power, furnished every instant by the apparatus controlled by the counter. The intervals of time that separate two different gatherings may be read upon the dial of the clock, and the integrations made by the apparatus may be known from the horizontal dial, so that the consumer has under his eyes at every instant all the elements of verification that are necessary to him.

Clerc's meter, shown in Fig. 2, is in principle analogous to Blondlot's, but differs from it in the mode of periodical integration. The clock is kept in motion by a derivation from the line. It carries along, at a uniform angular speed, a crank fixed upon the principal axis. When the power expended is nil, the needle fixed upon the axis of the movable bobbin is in the position represented in the cut.

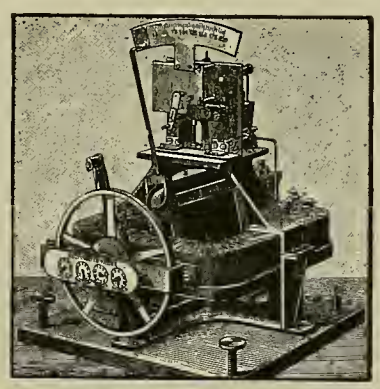


FIG. 2. ELECTRIC METER.

If a current passes into the two bobbins, the needle is deflected toward the right by an angle that counterpoises, properly arranged upon the axis, permit of rendering sensibly proportional to the product, eI. The crank carries the needle back to zero once per revolution.

These rotations are transmitted to the revolution counter, and totalized by means of a mechanical arrangement that may be seen in front in the figure. This arrangement consists essentially of a small finger suspended from a lever fixed to the axis of the movable bobbin. When the lever moves from right to left, it carries along the large wheel mounted upon the axis of the totalizer. In moving from left to right, the finger slides over the felly of the wheel, and the rotation effected in the preceding movement continues as in the Blondlot apparatus. The needle indicates the power in watts, and the counter, the total of the watt-hours furnished to the consumer.

The Paccaud-Borel meter is designed for the measurement of alternating currents. It belongs to the class of motor counters, and is based upon the special properties of the magnetic field produced by alternating currents of great frequency. Suppose there are two bobbins whose axes are arranged rectilinearly, having an unequal number of spirals, and mounted in derivation, one with respect to the other, so that the total current traverses them at the same time and divides itself unequally at every instant in each of them in consequence of irregularity of the coefficients of self-induction. Each of these bobbins will tend to produce a magnetic field whose intensity will depend at every instant upon the intensity of the current traversing it. The resulting field will be rotary in a direction determined by the attachment of the terminals between themselves. A thin iron disk placed in the rotary field will tend to turn in the direction of rotation of the field, and so much the more quickly in proportion as the field and the current producing it is more intense. Upon arranging vanes, forming a regulator upon the same axis with the disk, and upon properly proportioning the different parts of the apparatus, it is possible, as may be seen, to form a sort of electric motor, which, between certain limits, will revolve with an angular speed sensibly proportional to the efficacious intensity of the total current.

It is with a view to obtaining such necessary proportions as perfectly as possible that the practical apparatus does not entirely resemble the theoretical one that we have just described.

In the model represented in Fig. 3 one of the magnetic fields is produced by an electro-magnet; on another hand the vanes of the brake are movable, and they rise in order to preserve the proportionality at great distances in reducing the value of the resistant couple due to the air. The number of revolutions registered upon a counter is proportional to the quantity of efficient electricity furnished to the circuit. For the cuts and descriptions of the above apparatus we are indebted to *La Nature*.

Removal of Police Telephones in Chicago.

Considerable attention has been given to the action of the Chicago Telephone company in removing fifteen instruments from police stations and offices in the city buildings, and in one instance at least, facts have not only been suppressed or distorted, but statements have been published which were in direct contradiction of those that were made to the reporter. The action of the telephone company was directed by City Electrician Barrett, who ordered the instruments removed. To explain this it is only necessary to recall the fact that the Chicago Telephone company under a franchise granted January, 1889, were directed to furnish the city nine instruments free of charge, to be located in the mayor's office, the department of public works, the fire department, the police department, the building department, the office of city collector, the office of city clerk, the health department, and the law department. The ordinance also required that on the first days of January and July the president and secretary of the company should submit a statement of the gross earnings, upon which a tax of 3 per cent. was levied. When the bills for the remaining fifteen telephones were presented, it was found there was no money to pay them, and the service was accordingly discontinued.

The occasion served as an opportunity for the daily papers to abuse the telephone company. One of these went a trifle too far, however, and said: "Prof. Barrett intimated that the telephone people sent in bills for these telephones as a retaliation for the tax of 3 per cent." This statement the city electrician pronounced false. "The telephones had to go because there was no fund or appropriation to pay the bills. Under the ordinance the telephone company is obliged to furnish the city free of charge just nine telephones. Beginning with nine instruments the number was increased from time to time, until twenty-five were in use. The fifteen telephones ordered removed cost annually $1,975. There is no money for that expenditure."

It appears that these instruments in question were not used for official business exclusively, in fact, this formed a very small portion of the service. The reason the daily papers take such an interest in the matter is the inconvenience it will put them to. The official police work is done almost exclusively through the independent police and fire service and the instruments that were removed were used chiefly by the newspaper reporters and persons in the vicinity of the police stations. It will therefore be of little inconvenience to the public or the police department.

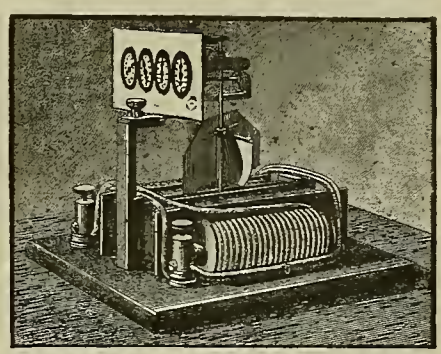


FIG. 3. ELECTRIC METER.

New Arc Light Station in Chicago.

Another central station has been established in Chicago, to furnish light and power. The Central Illuminating & Power company, has installed an arc light plant on 22d street, between Wabash avenue and State street. The capacity of the plant is 120 arc lamps. The Western Electric company of Chicago installed the plant.

Western Electrician.

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J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium fo its special field. Advertising rates are moderate and will be promptly furnished on application.

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IN the supplement which accompanies this issue of the WESTERN ELECTRICIAN, are presented the portraits of the eminent scientists, whose names are universally employed to designate the practical electrical units. F. B. Badt, in an article on another page, gives short biographies of these famous men, who labored so zealously and successfully in the cause of science. It may not be out of place to state here that the preparation of the article involved no little labor. In spite of the fact that the names are so familiar, accurate information regarding the lives of these scientists whose biographies are published in this issue, is not easy of access. To complete these brief sketches, required protracted search and an extended correspondence; but the importance of presenting the matter in a consistent form seemed to warrant the labor devoted to the preparation of the article. It was an equally difficult undertaking to secure the likenesses which appear in the supplement. It was found necessary to send abroad for several of the portraits. The article and the series of portraits will be of interest, we think, to every reader of the WESTERN ELECTRICIAN.

THERE seems to be every reason for believing that the convention of the National Electric Light association at Kansas City, will be successful in every way. An article in another place in this issue give the latest news in regard to the meeting. President Weeks in a brief interview, states that the outlook is extremely promising.

AN interesting interview with Prof. Alexander Graham Bell, appears in the Kansas City letter. He has evidently been subjected to a good many of the annoyances accompanying greatness, as he speaks of a time when he thought he had at last reached a town which was without telephone, but alas, was sadly mistaken.

IT was stated a few weeks ago that the provisional government in Brazil had imposed an export tax on rubber at the request of a local company. All the exporters protested against the measure "in good set terms." According to a late dispatch the government has yielded to the pressure, and has removed the obnoxious tariff. The news may not be reliable, as reports from Brazil are not always accurate.

AT the last meeting of the Institute of Electrical Engineers Prof. W. A. Anthony read a paper on "A Review of the Modern Theories of Electricity." The article is presented elsewhere in this issue. The subject is one of great interest, and it is treated by Prof. Anthony in an able and entertaining way. His confident prediction of the solution by electrical engineers of a number of deep problems will be read with interest.

IN an interview given in another column, Harold P. Brown speaks of the latest arrangements which have been made for inflicting the death penalty by means of electricity. Doubtless the reporter who wrote the interview "dressed it up" somewhat, but certainly the glib and flippant manner in which the gruesome details of executions are referred to, is in abominably bad taste. Executions even by electricity hardly constitute a subject which should be discussed in a trifling, frivolous spirit.

AN illustrated article of more than ordinary interest in this issue, describes Lieut. Fiske's method of locating the position of distant objects. The system is to be put into service on the United States cruiser Baltimore. The method which Lieut. Fiske has devised was designed especially to enable gunners to point cannon accurately at distant objects where by reason of smoke or fog they cannot be seen. The method is extremely ingenious, and the practical application will be watched with interest.

THE movement to secure lower telephone rates has again been started in Cleveland. A bill has been prepared which the legislature will be asked to pass. According to its provisions no telephone company in Ohio is to be allowed to charge over $3 per month for the rental of an instrument. The maximum toll charge is limited to fifteen cents for the first five minutes' conversation, and ten cents for each succeeding five minutes. The measure has a penal clause providing for fines and imprisonment in cases of where rates higher than those mentioned are charged. These provisions are the same as the majority of telephone bills considered by state legislatures last winter. Probably its fate will be the same as that which overtook those measures. Such a wholesale reduction as the bill contemplates, is absurd.

THE people of New York are beginning to realize that a grave injustice was done the electric lighting companies by the Board of Electrical Control, when that body adopted its wild project of wholesale destruction of property in order to divert public opinion from the real point at issue—the failure of the board to perform its duty. Business men experienced in electrical affairs, but in no way connected with any of the electric light companies, say the damage to those corporations that has been uselessly and unnecesarily inflicted, will exceed $1,000,000, and that burdens have been put upon the companies which will increase their deficit by another million before the end is reached. Incalculable damage to electrical progress has also been done by New York's demonstration of how easy it is to depress electric light securities.

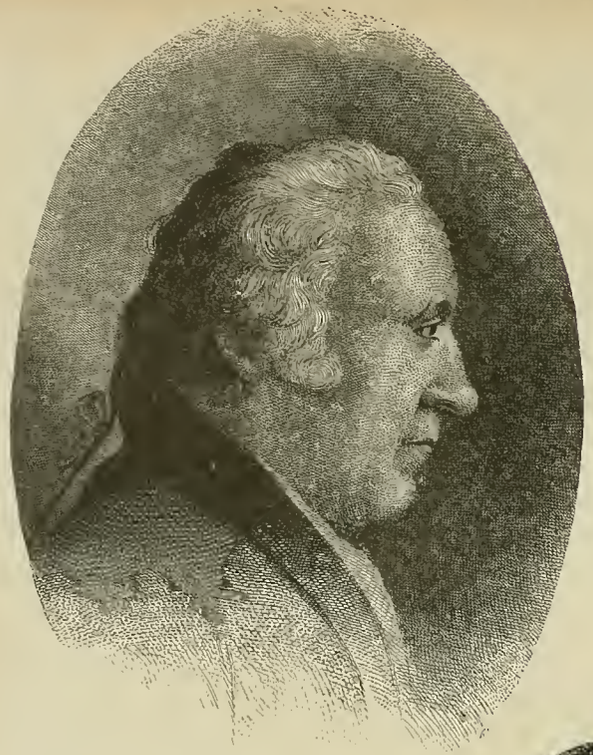
LEGISLATIVE investigation is becoming more and more, of a craze. Here is a resolution which was introduced in the New York senate last week.

"*Resolved*, That the Committee on General Laws of the senate be authorized to investigate the methods employed in furnishing electricity for lighting and power purposes as now conducted in this state, and such other matters connected with said business, and to report to the senate on or before April 1, 1890, such recommendations as the committee may deem proper for the information and guidance of the senate in framing proper legislation for public safety. The committee is further authorized to summon witnesses, send for books and papers, employ experts and stenographers and to sit whenever and wherever it pleases." Senator Erwin, the author of the measure, defended it by saying there was a general demand for such an investigation as the resolution contemplated. This statement is more than doubtful; what is needed beyond that which the census office is trying to do, it would be hard to explain. A New York paper says, "This is simply the unloosing of another pack to make forays on the metropolis."

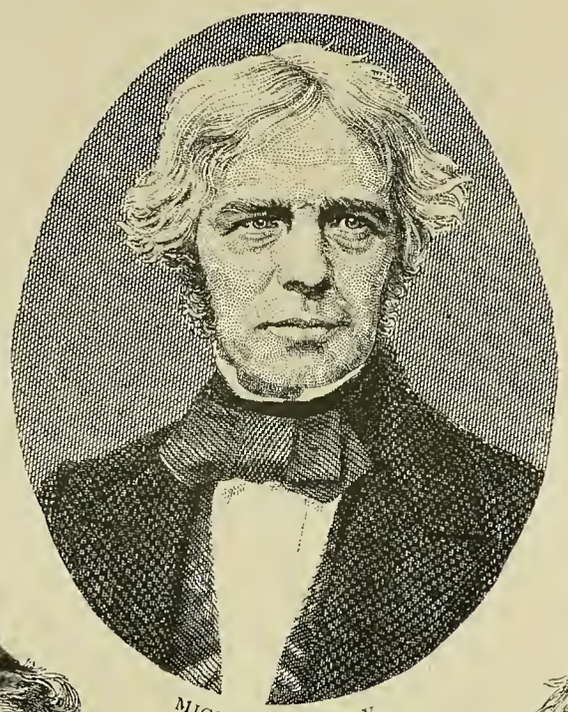
CITY ELECTRICIAN BARRETT of Chicago, continues to oppose overhead wires with his accustomed vigor, and his position on this question has caused members of electric light companies in the suburbs of Chicago, considerable apprehension. It is conceded that the companies have a legal right to string wires overhead under franchises granted them before their respective districts were annexed to Chicago, yet the mayor hoped under the police laws to prevent them from doing so. The law department of the city government questioned the right of the city to rescind the ordinances of the suburban districts, which the annexation act had declared should be respected, and on the other hand the mayor and city electrician considered it unfair to compel the companies in the old district to bury their wires and allow the new companies to maintain overhead circuits. After several conferences, representatives of the companies agreed if permitted to go on with their work, to string their wires only where they would not interfere with existing lines, and in no case on the same side of the street with telegraph and telephone wires. Wherever practicable, the poles and wires will be placed in alleys or carried over house tops. In crossing streets on which telegraph and telephone lines are already established, the new companies will be required to go underground. It is expected this proposition will be accepted.

THE work of organizing state associations of electric lighting companies is receiving the encouragement the movement deserves. The reasons for such organizations are obvious. The growing tendency of legislators to make political capital by enacting, or at least advocating, laws encroaching on the rights of corporations, warrants the organization of these companies to protect themselves against adverse legislation. Those who have followed the course of the Illinois legislature will remember the efforts made during the last session, to secure the passage of laws affecting at least one department of electrical activity, and those who were interested in this field will remember the struggle that was required to defeat the passage of the bill. This has naturally suggested to those interested in other electrical fields the necessity of providing against like contingencies, and it is agreed that the only practical method to pursue is to secure thorough organization. Therefore the officers of the Illinois State Electric Lighting association are endeavoring to interest every central station company in the state, and secure their co-operation in this important movement. The enterprise is worthy the attention of managers of central stations, and should receive their support.

The policy adopted by the electric light companies is commended by *Light, Heat and Power*, a gas journal published at Philadelphia, and the attention of the gas companies is directed to the advantages to be derived from this course.



JAMES WATT.



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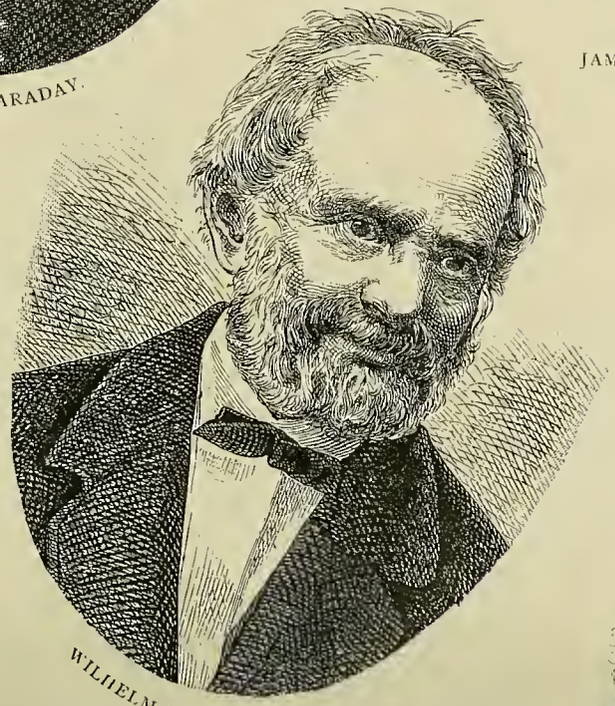

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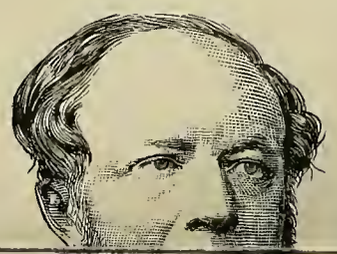
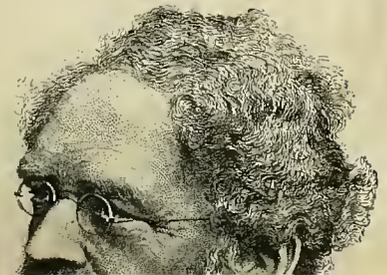
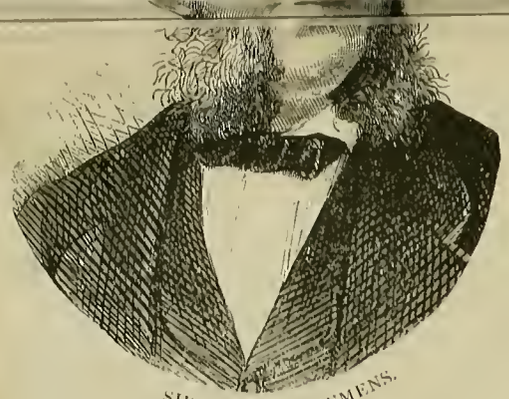


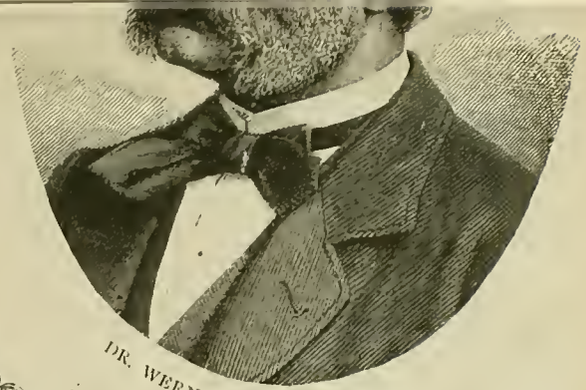




SIR WILLIAM SIEMENS.

COUNT ALESSANDRO VOLTA.

ANDRE MARIE AMPERE.



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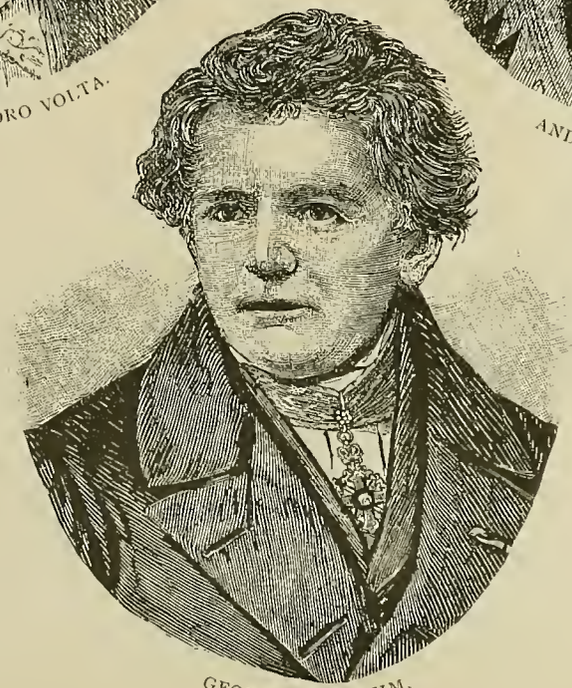
JOHN FREDERICK DANIELL.



GEORG SIMON OHM.

MORITZ HERMANN VON JACOBI.

PORTRAITS ACCOMPANYING "PRACTICAL ELECTRICAL UNITS."

Practical Electrical Units.

By F. B. Badt.

The statement is frequently made that the calculations of electricians are mere guesswork, because we do not understand the nature of electricity. Such an assertion is, of course, absurd. Mathematics is an exact science, whether applied to astronomy, hydraulics or electrical engineering. While they do not know what gravitation is, astronomers are able to calculate eclipses of the sun and moon, and the movements of celestial bodies with absolute accuracy. Thus it is in dealing with electricity; while we may know little of its nature, we are still enabled by means of mathematics and by a knowledge of the simple laws discovered by Ampere, Ohm, Joule and others, to make calculations with entire accuracy.

Gauss first proposed the substitution of absolute units for measuring electrical quantities in place of the arbitrary units used up to his time. He showed that all quantities could be referred to the fundamental units of length, time and mass. The unit of length now adopted is the centimeter; the unit of time is the second, and the unit of mass is the gramme. These units which form the means of measurement called the Centimeter-Gramme-Second system, or the C. G. S. system, are known as the absolute or C. G. S. units.

Practical units, however, were adopted for the reason that the absolute units for the several electrical quantities were found to be either too great or too small for practical measurements. Multiples of the absolute units, therefore, were adopted as practical units, and the names of the most prominent scientists who had worked to build up a practical system of measurement were selected as terms to designate them.

During the last few years the writer has received numerous letters asking for information relative to the derivation of these units. He had hoped that an adequate explanation of the origin of the terms would be found in Prof. Houston's "Dictionary of Electrical Words, Terms and Phrases," but he was disappointed. One looks in vain for derivations of the units and for biographies of the scientists, whose names are employed to designate them. That this information might be readily accessible, the writer undertook the preparation of this article.[1] In the supplement which accompanies this issue of the Western Electrician are presented with one exception the portraits of all the eminent scientists by whose names the practical units are or were designated. The portrait of Coulomb is missing, and it is extremely doubtful if there is one extant. In the accompanying table is presented a summary of the information relating to the practical units. Following are short biographies of the eminent men whose work marked signal advances in scientific attainment, and whose names are or were the familiar designations of the practical units:

WEBER.

Weber, Wilhelm Eduard, born at Wittenberg, October 24, 1804. In 1831 he was professor of physics at the University of Goettingen and in 1843 was professor at the University of Leipzig. In 1849 he is found again at the University of Goettingen. He published with Gauss from 1836–'41 the results of observations of the Magnetic association. (See Gauss.) In 1840 he published the "Atlas of the Earth's Magnetism." From 1846 to 1878 he compiled "Electro-Dynamische Massbestimmungen," (Electro-dynamic measurements.) In this latter work Weber introduces the system of absolute units.

In the earlier stages of the science several units were introduced for the measurement of quantities dealt with in electricity. In illustration may be mentioned the wire of Jacobi (25 feet of copper wire weighing 345 grains), the mercury column of Siemens (a meter long, with a section of a square millimeter), which at given temperatures furnished units of resistance, and the Daniell cell, which furnished the unit of electromotive force. Jacobi's current unit was based on the electrolytic decomposition of water. One cubic centimeter of oxy-hydrogen gas is formed each minute. All these units were perfectly arbitrary, and there was no connection of any kind between them. The introduction of a rational system of unitation, based on the fundamental units of time, mass and length, was one of the greatest achievements of modern times. The impulse came from the famous memoir of Gauss, "Intensitas vis Magneticæ Terrestris ad Mensuram Absolutam Revocata" in 1832. (See Gauss.) In conjunction with Weber, he introduced his principles into the measurement of the earth's magnetic force.

To Weber belongs the credit of doing a similar service for electricity. He not only devised three different systems of such units—the electro-dynamic, the electrostatic, and the electro-magnetic, but he carried out a series of measurements which practically introduced the last two systems.

The practical units which are in use to-day are simply certain multiples of the absolute or Centimeter-Gramme-Second (C. G. S.) units. The absolute units are either too great or too small for practical use and for convenience the "practical units" were adopted to which the names of the most famous electricians are given.

Weber was the most illustrious among the successors of reigning duke. He was appointed director of the Goettingen Observatory in 1807, an office which he retained to his death. The story goes that he always slept under the roof of his observatory except on one occasion, when he accepted an invitation from Humboldt to attend a meeting of natural philosophers at Berlin. His first work on the "Theory of Magnetism" was published in 1832 (Intensitas vis Magneticæ Terristris ad Mensuram Absolutam Revocata). Shortly afterward he constructed in conjunction with Professor Wilhelm Weber new apparatus for observing the earth's magnetism. One of these instruments is the bifilar magnetometer. With Weber's assistance he erected in 1833 at Goettingen a magnetic observatory free from iron. From this observatory he sent telegraphic signals to a neighboring town, thus demonstrating for the first time the practicability of an electro-magnetic telegraph. He organized the Magnetic association, whose continuous observations (1836-41) on fixed days extended from Holland to Sicily. The results of the observations were published from 1836 to 1839. Gauss was well versed in general literature and the chief languages of modern Europe, and was a member of nearly all the leading scientific societies in Europe. His collected works were published by the Royal Society of Goettingen, comprising seven volumes, 1863 to 1871: (1) "Disquisitiones Arithmeticæ;" (2) "Theory of Numbers;" (3) "Analysis;" (4) "Geometry and Method of Least Squares;" (5) "Mathematical Physics;" (6) "Astronomy," and (7) "Theoria Motus Corporum Cœlestium." Sir William Thomson proposed the name of Gauss for the unit of intensity of magnetic field. This practical unit has been generally adopted. It is equal to 10^8 C. G. S. units.

AMPERE.

Ampere, Andre Marie, born at Lyons January 22, 1775; died at Marseilles June 10, 1836. Ampere is the founder of the science of electro-dynamics. (See Ampere.) He greatly improved the construction of the galvanometer, and invented the electro-dynamometer. To these instruments he applied the mirror scale and telescope method of reading which had been suggested by Poggendorff and used by him and Gauss in magnetic measurements about 1833. In 1846 he tested by means of his improved apparatus the fundamental laws of Ampere. The result of his researches was to establish the truth of Ampere's principles as far as experiments with closed circuits could do so, with a degree of accuracy far beyond anything attainable with the simple apparatus of the original discoverer.

Applying his improved instruments he also obtained accurate verifications of the laws of induction, which by this time had been developed mathematically by Neumann and himself. The experiments of Weber must be considered as the experimental evidence establishing the theory of Ampere, and as such they form one of the corner stones of electrical science. Clausius and Siemens proposed the term Weber for the practical unit of the strength of the magnetic pole. This unit is equal to 10^8 C. G. S. units. The term has not yet been generally adopted as a practical unit. The term Weber was formerly employed to designate the unit of strength of current. This term is now replaced by the ampere.

GAUSS.

Gauss, Carl Friedrich, born at Brunswick, April 30, 1777; died at Goettingen Feb. 23, 1855. Gauss was born of humble parentage. He received an education, thanks to the notice which his talents procured for him from the

[1] Several portraits presented in the Supplement were obtained from friends in the United States and abroad. A large number of books and periodicals was consulted both for portraits and biographies. The writer is especially indebted to Encyclopædia Britannica; E. Jacques' Dictionaire d' Electricite et de Magnetisme; Otto Spamer's Conversations Lexicon; Brockhaus' Conversations Lexicon; *Popular Science Monthly;* Les Merveilles de la Science par Louis Figuier "Invention;" The London *Electrician;* Trades' Directory; Hartlebeos' Electrotechnische Bibliothek, and many others.

PRACTICAL MAGNETIC AND ELECTRO-MAGNETIC UNITS.

PREPARED FOR THE WESTERN ELECTRICIAN, FEBRUARY 1, 1890.

BY F. B. BADT.

Quantities to be Measured.	Synonyms.	Symbol.	Name of Practical Unit Now in Use.	Obsolete Names.	Comparative Values.	Value in C. G. S. or Absolute Units.	Dimensions of the Absolute Units. L=Length. M=Mass. T=Time.	Remarks. Fundamental or absolute or C. G. S. Units are: Centimeter (C) for Length. Gramme (G) for Mass. Second (S) for Time.
Strength of Pole.	Quantity of Magnetism.	M.	Weber.		$\sqrt{\text{Force}\times(\text{Distance})^2}$.	1^{18}	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$	The pole of unit strength is that which, at a distance of one centimeter, repels an equal and similar pole with a force of one dyne. The dyne is that force which, acting for one second on a body weighing one gramme, is able to move it at a velocity of one centimeter per second.
Intensity of Magnetic Field.	Intensity of Magnetization.	H.	Gauss.		Force÷Strength of Pole.	10^8	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	The field of unit intensity is that which acts with a force of one dyne on a magnetic pole of unit strength.
Current.	Strength. Intensity. Rate of Flow. Coulomb Per Second. Volume (obsolete).	C.	Ampere.	Farad. Weber Per Second. Jacobi. Daniell÷Siemens.	Coulombs÷Seconds. Volts÷Ohms.	10^{-1}	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	One Ampere deposits .00032959 gramme, or .005084 grain of copper per second on the plate of a copper voltameter.
Quantity.	Ampere-Second.	Q.	Coulomb.	Weber.	Amperes×Seconds.	10^{-1}	$L^{\frac{1}{2}}M^{\frac{1}{2}}$	One hour=3,600 seconds; hence one ampere-hour=3,600 ampere-seconds, or=3,600 Coulombs.
Electromotive Force. Difference of Potential.	Pressure. Tension.	E.M.F. or E.	Volt.	Daniell.	Amperes×Ohms. Joules÷Coulombs.	10^8	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-2}$	One volt=.926 standard Daniell cell.
Resistance.		R.	Ohm.	Siemens.	Volts÷Amperes.	10^9	LT^{-1}	The unit of self induction which manifests itself as apparent increased resistance is the Secohm (Second×Ohm), which equals 10^9 C. G. S. units.
Capacity.		K.	Farad.		Coulombs÷Volts.	10^{-9}	$L^{-1}T^2$	The Microfarad, one millionth of a Farad=10^{-15} C. G. S. units, has been generally adopted as a practical unit; the Farad is too large a unit for practical use.
Power. Activity.	Electrical Horse Power Rate of Doing Work. Effect Work÷Time.	P or Pw or H. P.	Watt (Volt-ampere)		Volts×Amperes. (Amperes)²×Ohms. (Volts)²÷Ohms. Joule÷Seconds.	10^7	L^2MT^{-3}	One Watt=$\frac{1}{746}$ electrical horse power. One electrical horse power=$\frac{\text{Volts}\times\text{Amperes}}{746}$. One electrical horse power=$\frac{(\text{Amperes})^2\times\text{Ohms}}{746}$. One electrical horse power=$\frac{(\text{Volts})^2}{746\ \text{Ohms}}$
Work. Heat. Energy.	Power×Time.	W. or Wj	Joule (Volt-coulomb.)	Joulad.	Watts×Seconds. Volts×Coulombs. (Amperes)²×Ohms×Seconds. (Volts)²×Seconds÷Ohms.	10^7	L^2MT^{-2}	One Joule is the work done or heat generated by a Watt in a second. One Joule is the heat necessary to raise .228 gramme of water 1° C. or one Joule=.238 calorie or therm. One joule=.7375 foot pound in a second.

of the science of electro-dynamics. He was enthusiastic in the pursuit of knowledge from his childhood, and according to tradition he worked out sums by means of pebbles before he knew the figures. In later life he was accustomed to say that he knew as much about mathematics when he was 18 as ever he knew, but his reading embraced history, travels, poetry, philosophy and the natural sciences. From about 1796 Ampere gave private lessons at Lyons in mathematics, chemistry and languages. In 1801 he removed to Bourg, where he was professor of physics and chemistry. After two years' absence he returned to Lyons as professor of mathematics at the Lyceum. In 1809 he was elected professor of analysis at the Polytechnic School at Paris. Here he continued to prosecute his scientific researches and his multifarious studies. He was admitted to membership in the institute in 1814. He established the relations between electricity and magnetism. On his development of the science of electromagnetism, or as he called it, "electro-dynamics," his fame rests. On the 11th of September 1820, he heard of the discovery of Professor Oersted of Copenhagen that the magnetic needle might be deflected by a voltaic current. He set to work at once to develop the important consequences which this discovery involved. Physicists had long been looking for the connection between magnetism and electricity, and had, perhaps, inclined to the view that electricity was in some way to be explained as a magnetic phenomenon. Such ideas in part led Oersted to his discovery. Ampere proved that the explanation was to be found in an opposite direction. He discovered the ponderomotive action of one electric current on another, and by a series of well-chosen experiments he established the elementary laws of electro-dynamic action. Starting from this point, by a brilliant train of mathematical analysis, he not only evolved the complete explanation of all the electro-magnetic phenomena observed before him, but predicted the discovery of many new facts. On September 18, 1820, he presented a paper to the academy, containing a far more complete exposition of the phenomenon observed by Oersted, which he had in the interval investigated by experiments, and he proved that magnetic effects can be produced without magnets, but by means of electricity alone. In particular he showed that the attraction or repulsion of two wires connecting the opposite poles of a battery depends on whether the currents pass in the same or in opposite directions. According to his beautiful theory of magnetism, every molecule of magnetic matter is acted on by a closed electric current, and magnetization takes place in proportion as the direction of these currents approaches parallelism.

This theory of molecular currents gave an explanation of that connection between electricity and magnetism which had been the dream of previous investigators. Hardly any advance in the science of electricity can compare in point of completeness and brilliancy with the work of Ampere, if we except the discovery of the laws of induction by Faraday ten years later.

Ampere anticipated the invention of the electric telegraph, as he suggested in 1821 an apparatus having a separate wire for each letter.

To Ampere is due the invention of the solenoid and several other kinds of apparatus which he constructed for the purpose of demonstrating his theories experimentally. The great amiability and childlike simplicity of Ampère's character are well brought out in his "Journal et Correspondence," published by Madame Chevreux, Paris, 1872. His most remarkable reports are found in the publications of "L'Academie des Sciences," or in the "Annals de Physique et de Chimie." The Paris Electrical Congress of 1881 adopted the ampere as the practical unit of the strength of the electric current. This practical unit is equal to 10^{-1} of the C. G. S. unit.

COULOMB.

Coulomb, Charles Augustin, born at Angoulême, June 14, 1736, died at Paris, August 23, 1806. Coulomb belonged to a noble family of Montpellier. He chose the profession of military engineer. He gained great distinction in 1773 by his "Statistical Problems Applied to Architecture," which he presented to the Academy of Sciences in 1779; he shared with Van Swinden the prize for improvements in the construction of compasses. In 1781 he was stationed permanently at Paris. He was appointed inspector of public instruction in 1802, but his health was already very feeble and four years later he died. He had the rank of lieutenant-colonel of engineers. His fame rests chiefly on his most elaborate and important investigations in electricity and magnetism, and on his invention of the torsion balance in 1777. This instrument has since his time been universally used in all delicate researches, particularly in the measurement of electrical and magnetic actions. Coulomb proved, by a series of elaborate experiments, in opposition to the generally accepted theories of Cavendish, that electricity, like gravity, varied in the inverse ratio of the square of the distance. Adopting the two-fluid hypothesis, Coulomb investigated the distribution of electricity on the surface of bodies. His experiments on the dissipation of electricity possess a high value. He found that a thread of gum-lac was the most perfect of all insulators; it insulated ten times as well as dry silk thread. He found that a silk thread covered with fine sealing wax insulated as effectually as gum-lac when it had four times its length. He ascertained that the dissipation of electricity along insulators was chiefly due to adhering moisture, but in some measure also to a slight conducting power. His writings were collected by the Societe de Physique, and thanks to Monsieur Potier, form Volume I of the Memoirs relating to Physics. The Paris Electrical Congress of 1881 adopted the name of Coulomb as the practical unit of electrical quantity. The coulomb is equal to 10^{-1} of the C. G. S. unit of quantity.

VOLTA.

Volta, Count Alessandro, born at Como, Feb. 18, 1745, died in same city, March 6, 1827. He was appointed professor of physics in the Gymnasium of Como in 1774. In 1777 he left his native city and traveled through Switzerland, where he and De Saussure became intimate friends. In 1779 a chair of physics was founded in Pavia and Volta was chosen to occupy it. In 1782 he undertook a journey through France, Germany, Holland and England, and became acquainted with nearly all the scientific celebrities of that day. In 1791 he received the Copley medal of the Royal Society. In 1801 Napoleon, then first consul of the French Republic, called him to Paris that he might see his experiments on contact electricity. A medal was struck in his honor. He was made a senator of the kingdom of Lombardy, member of the Academy of Sciences, and received 6,000 francs as a present. In 1815 the emperor of Austria made him director of the philosophical faculty of Padua. In 1819 he retired and settled in his native town. Volta is the inventor of the electrophorus, the condenser, the straw electrometer and the electric pile. Volta's electric pile was first described in a letter to Sir J. Banks, then president of the Royal Society. This letter, which was dated March 20, 1800, was read before the society on June 26 of that year. The pile consisted of a number of disks of zinc and an equal number of silver or copper disks. The zinc and copper plates were in contact, and each pair was separated by porous matter which was kept moist. He described a number of experimental results obtained with this pile, and finally showed that all the effects produced were the same as those which could be obtained from electrical machines and that therefore "galvanism" and "electricity" were identical. Volta was led to the invention of the electric pile by the astonishing discoveries of Galvani in 1790. It is very instructive to read the letters and essays in which Volta describes his observations and his reasoning which gradually led him up to the construction of the electric pile. The muscle of the frog soon appeared to him to be nothing but a very delicate electrometer and not, as was first thought, the source of electricity. Volta lived to see the remarkable development of his science by Sir Humphrey Davy, Oersted and Ampere, but he was no mathematician and the subject grew beyond his ability to grasp it. He recognized this fact with that frank honesty which is apparent in all his writings and during the last twenty-five years of his life he published nothing on electrical subjects. The Paris Electrical Congress of 1881 adopted the word volt (abbreviation of the name of Volta) as the practical unit of electromotive force. It is equal to 10^8 C. G. S. units.

OHM.

Ohm, Georg Simon, born at Erlangen, Bavaria, March 16, 1789. Died at Munich, July 17, 1854. The exact year of his birth is in doubt. Ohm was the son of a locksmith in Erlangen, Bavaria, and in his boyhood, following the custom prevailing in European states, he worked in his father's shop. Very early in his life he turned his attention to physical science, and having been educated in the university at Erlangen and becoming an accomplished mathematician, he was in 1808 appointed professor of physics in the gymnasium in Cologne. In 1817 he became professor of mathematics in the Jesuits' college in Cologne, and in 1818 published his first work, on the "Elements of Geometry."

After a few years in Cologne he resigned his professorship and went to Berlin. He had become deeply interested in the phenomena of galvanic electricity. Galvani had discovered in 1790 that the contact of metals produced a current of electricity which developed muscular contraction in the frog, and in 1800 Volta had invented the electric pile. Pushing his researches in these directions, by the aid of his mathematical attainments, Ohm became convinced that the flow of the electric current was governed by fixed laws, and he bent his energies to the discovery of those laws. The result of his studies was embodied in his famous work published in 1827 and entitled "Die galvanische Kette mathematisch bearbeitet" (the galvanic circuit mathematically determined). This work was only a pamphlet, but its importance was far-reaching, for here is found what has ever since been known as "Ohm's Law." In 1833 Ohm became the director of the Polytechnic School at Nuremberg. In 1852 he was made professor of experimental physics in the University of Munich.

Ohm's law completely changed the methods of measuring electric quantities. Before his discovery the quantitative circumstances of the electric current had been very vaguely indicated by the words "intensity" and "quantity," but these words indicated nothing definite. By Ohm's law, however, it became for the first time possible, accurately, to define and measure electromotive force, strength of current and resistance.

Ohm's law states that the current strength is directly proportional to the electromotive force, and inversely proportional to the resistance. This is generally written as a formula $C = \frac{E}{R}$; in which C represents current strength (in amperes), E electromotive force (in volts), and R resistance (in ohms.)

It may be doubted whether Ohm's investigations could have been made without the aid of the magnificent work of Fourier on the conduction of heat. In fact, the equation for the propagation of electricity formed on Ohm's principles, is identical with that of Fourier for the propagation of heat; and if in Fourier's solution of any problem of heat conduction, we change the word "temperature" to "potential" and write "electric current" instead of "flux of heat," we have the solution of a corresponding problem of electric conduction.

Ohm introduced for the first time into the theory of the galvanic pile the equivalent of the modern word "potential." Ohm's word was "electroscopic force" or "tension," and he showed that with the same current strength the fall of potential is uniform along a homogeneous linear conductor of even cross-section.

Ohm continued a long course of experiments with the thermo-electric pile, and when he had become thoroughly satisfied as to the correctness of his theory, he published his book. Like almost all other discoverers he was ahead of his time. The value of Ohm's work was but imperfectly recognized until it was stamped by the award of the Copley medal of the British Royal Society in 1841. This society is now co-operating with German scientific societies in the erection of a statue in honor of Ohm at Munich, the capital of Bavaria, his native country. Since his birth a century had passed on March 16, 1889. The Electrical Congress of Paris in 1881 adopted Ohm's name as that of the practical unit of resistance. The ohm is equal to 10^9 C. G. S. units.

FARADAY.

Faraday, Michael, born at Newington near London September 22, 1791; died at Hampton Court, Sussex, on August 25, 1867. His father, James Faraday, a native of Yorkshire, obtained his livelihood as a working blacksmith. Faraday's education as a child, was of the most ordinary description, comprising little more than the rudiments of reading, writing, and arithmetic, obtained at a common day-school in the neighborhood. At 13 he went to Mr. Riebau, of Blandford street, to whom he was apprenticed in the following year, to learn the business of bookseller and bookbinder, and continued to work at that trade till 1812. During his term of apprenticeship, a few scientific works occasionally fell into his hands. These he read with avidity, and aided by patient study and such rough experiments in chemistry as could be accomplished by a youth with little leisure, and still less pocket money, he gradually mastered their contents. Among these were "The Treatise on Electricity," the "Encyclopædia Britannica," and Mrs. Marcet's well-known "Conversations on Chemistry." The perusal of the former led to the construction of his first electrical machine with a glass phial, on which he afterward improved by constructing another with a proper cylinder, and added other simple apparatus for the purpose of making a variety of experiments with electricity. Through the kindness of Mr. Dance, a member of the Royal Institution and a customer of his master, Faraday was enabled to attend the last four lectures delivered in that building by Sir Humphrey Davy in the early part of 1812. Of these he took careful notes, from which he wrote out the lectures in a fuller form, interspersing them with such drawings as he could make to illustrate their contents. His strong desire for some scientific occupation, even of the humblest kind, induced him to write in the December following to Sir Humphrey Davy, inclosing his notes and illustrations as a proof of his earnestness in the cause of science. The reply was prompt as well as kind and favorable, nor was it without its results. Early in 1813, his patron, acting for the managers of the Royal Institution, offered him the situation of chemical assistant under himself, as honorary professor, and Mr. Brande as professor of chemistry. This post he accepted, and shortly afterward entered upon his duties, taking up his residence at the Royal Institution, where he chiefly resided. In the autumn of the same year Mr. Faraday went abroad as assistant and amanuensis of Sir Humphrey Davy, and returned to England in 1815, when he resumed his place at the Royal Institution. After a number of varied experiments, of which he published accounts from time to time in scientific journals, in 1820 he discovered the chlorides of carbon, in 1821 the mutual rotation of the magnetic pole and an electric current, and in 1823 some new and important facts as to the condensation of gases. In 1829 he labored hard, and as he thought at the time fruitlessly, on the production of optical glass; but though unsuccessful in his immediate object, his experiments produced the heavy glass which afterward proved of great assistance to him in his magnetic investigation. In 1831 the series of "Experimental Researches in Electricity," published in the "Philosophical Transactions," began with the development of the induction of electric currents, and the evolution of electricity from magnetism. He took up the investigation of the chemical decompositions effected by the electric current. In 1833 he announced his great law of electro-chemical equivalents, which made an epoch in the history of this department of electricity. He recognized and for the first time thoroughly explained the essential features of the phenomenon. Faraday's discovery gave a new measure of the current, and he invented the voltameter. In 1846 he received at one time the Royal and the Rumford medals for his discoveries in diamagnetism, and of the influence of magoetism upon light. In 1847 he declared the magnetic character of oxygen, and the magnetic relations of flame and gases.

It should be observed that the "Researches," though termed "Experimental," contain many hypothetical ideas and many inquiries into theories generally adopted up to their time. Among these may be specified the consideration respecting static induction, atmospheric electricity and those relating to lines of force, both representative and physical, which, having sufficiently stated his views, he was content to leave for solution to time and future experience. It may be added that his last hypothetical view relates to the conservation of force, a generalization which later researches have established; and that one of his latest papers treats of the division of gold and other metals. The researches of Faraday were pursued almost exclusively in the Royal Institution, Albermarle street, London, where he delivered lectures on scientific subjects every year from 1827, when he first appeared at the lecture table in the great theater. In conjunction with his friend, Mr. Brande, he had, for some three years previously, delivered early morning lectures to students in the laboratory. In 1833, when Mr. Fuller founded the chair of chemistry called after his name, in the Royal Institution, he nominated Mr. Faraday the first professor, expressly desiring that he should hold the chair as long as he was attached to the institution without being required to give lectures or having any other duties exacted of him in consideration of the value of his researches to the cause of science. In November, 1835, Professor Faraday received from Lord Melbourne's government a pension of £300 per annum as a recognition of the importance of his scientific discoveries. In 1836 he was appointed scientific adviser on lights to the Trinity House, and became a member of the senate of the University of London. In 1825 Professor Faraday

was elected corresponding member of the Academy of Sciences, a Paris; in 1825, a fellow of the Royal Society' and in 1832, the University of Oxford conferred upon him the honorary degree of Doctor of Civil Law. Numerous foreign orders were showered upon him, and he was a member of many learned and scientific bodies. He might have had a title, but his ambition did not lie that way and he always refused such offers. The Paris Electrical Congress of 1881 named in his honor the practical unit of electric capacity the "Farad." This term was also applied previously to the unit of current strength which is now measured in amperes. One Farad is equal to 10^{-9} of the C. G. S. unit.

WATT.

Watt, James, born at Greenock, January 19, 1736; died at Heathfield, August 19, 1819. His father was a small merchant at Greenock, who lost his little fortune by unsuccessful speculation, and the son at an early age was thrown on his own resources. He developed when a boy a taste for mechanics and at the age of 19 went to London to learn the trade of a scientific instrument maker. In 1756 he visited Glasgow to obtain work in repairing astronomical instruments and subsequently tried to establish himself as an instrument maker in Glasgow. As he had not served the full term of apprenticeship, the City Guilds refused him permission. The college took him under its protection and in 1757 he possessed the title of mechanical instrument maker to the university. Here Watt became acquainted with Black, the discoverer of latent heat, then a lecturer on chemistry, and a student by the name of Robinson, who afterward became professor of natural philosophy. The three frequently discussed the possibility of improving the steam engine, of which, at that time, Newcomen's was the most advanced type. His engines were at that time applied only to pumping water, generally in mines. They were so clumsy and wasteful of fuel that they were but little used. Watt commenced a very close study of this steam engine and of the properties of steam. In 1769 he took out his first patent, which covers nearly all the features of the modern steam engine. Watt's second steam engine patent is dated 1781. It describes five different methods of converting the reciprocating motion of the piston into motion of rotation so as to adapt the engine for driving ordinary machinery. The simplest way of accomplishing this is by a crank and fly wheel, a method which is still used to-day. In 1782 he took out the third patent covering a double acting engine; that is to say, both ends of the cylinder were alternately put in communication with the boiler and the condenser; up to that time, only one end of the cylinder was thus connected. Watt also covered in this patent, the system of expansive working in which the admission valve is closed after a portion only of the stroke is performed and the steam inclosed in the cylinder is then allowed to expand during the remainder of the stroke, thus doing additional work upon the piston. In 1784 he took out his fourth patent describing the well-known "parallel motion," an arrangement of links, by which the top of the piston rod is connected to the bottom so that it may either pull or push, and is at the same time guided to move in a sensibly straight line. Watt is considered to be the father of modern steam engineering. He invented the throttle valve and centrifugal governor by which the speed of rotative engines was automatically controlled. He is also the inventor of the steam engine indicator which draws a diagram of the relation of the steam pressure to its volume as the stroke proceeds. This instrument has played the most important part in the evolution of the steam engine. No engineer of to-day underestimates its value, and it is a surprising fact that the inventor of the modern steam engine also invented the instrument by which the working of the engine can be determined. Watt was the inventor of the letter copying press; he patented the device in 1780. In the year 1800 he retired from business and spent the remainder of his life at Heathfield Hall, his home near Birmingham, where he devoted his time to mechanical pursuits. The late Sir William Siemens proposed in 1882 to name the unit of activity or power exerted by one volt-ampere the Watt, in memory of the name of the famous inventor. This practical unit has been generally adopted. It is equal to 10^7 C. G. S. units.

JOULE.

Joule, James Prescott, born at Salford, near Manchester, December 24, 1818; died at Sale, near Manchester, October 11, 1889. When he was fifteen years of age he became a pupil in chemistry of Dalton, who first established the atomic theory and the principle of the indestructibility of matter. He entered into his work with enthusiasm, and not many months elapsed before he commenced a series of experiments with rude apparatus of his own contrivance. One of his first papers related to an electro-magnetic engine. It was published when he was nineteen years of age. Some idea of the immense amount of work performed by him may be gained when it is stated that in the Royal Society list there are titles of ninety-seven papers prepared by him besides twenty other important papers relating to researches undertaken by him in connection with Sir William Thomson, Sir Lyon Playfair and others. In these papers a great variety of scientific subjects was treated. In many of his experiments he had met with great difficulties arising as he said "from incomplete descriptions of apparatus, and from the arbitrary and vague numbers which are used to characterize electric currents. I have therefore determined for my own part to abandon my old quantity numbers, and to express my results on the basis of a unit which shall be at once scientific and convenient." The unit quantity of electricity according to his method was the quantity necessary to decompose nine grains of water. As a unit of resistance he adopted a copper wire of specific dimensions. He devised many improvements in galvanometers and as a result of a series of experiments laid the foundation for the department of thermo-dynamics. The statement of his discovery of the mechanical equivalent of heat was made at the Cork meeting of the British association in 1841. During the next few years he presented to learned societies many communications on the subject. These preliminary papers were summed up in an elaborate paper which he read before the Royal society in 1849. He summarized his investigations as follows: "The quantity of heat produced by the friction of bodies, whether solid or liquid, is always proportional to the quantity of force expended, and the quantity of heat capable of increasing the temperature of a pound of water by one degree Fahrenheit, requires for its evolution the expenditure of a mechanical force expended by the fall of 772 lbs. through the space of one foot."

Seguin in France and Mayer in St. Petersburg had also made noteworthy advances toward the establishment of the mechanical equivalent of heat. A hot controversy arose, especially in England, as to the relative merits of Mayer and Joule.

Joule distinguished himself also by his experiments with electric motors or, as they were formerly called, electro-magnetic motors. Early in 1841 he gave a lecture in the Royal Victoria gallery in Manchester, in which he gave the results of his experiments, referring also to what had been done by Jacobi in St. Petersburg in the way of applying electro-magnetism as a motive power (see Jacobi). Joule also found experimentally that the quantity of heat developed by an electric current in a conductor is directly proportional to the resistance of the conductor and to the square of current strength and to the time that the current lasts.

This law known as "Joule's law" is now generally expressed by the formula:

$$Wj = \frac{C^2 \times R \times t}{4.2}$$

Where Wj represents the quantity of heat or work; C the current strength in amperes, R the resistance in ohms; t the time in seconds and 4.2 Joule's equivalent.

Dr. Joule has figured but little in the fields of popular science. He became a fellow of the Royal Society in 1850, received the degree of B. C. L. from Oxford, of LL. D. from the Universities of Dublin and Edinburgh, and was president of the British association in 1873.

His work in pure science which was followed by practical results has been appreciated and gold medals and other marks of honor have been showered upon him. In 1878 a pension of £200 a year was conferred upon him by the British government. He lived a retired life as the result both of great modesty and poor health.

Siemens proposed in 1882 the "Joule" as a practical unit of electric work (heat or energy). This practical unit has been generally adopted. It is equal to 10^7 C. G. S. units.

SIEMENS.

Siemens, Dr. Werner von; born at Lenthe in Hanover, Dec. 13, 1816. He is the eldest and most famous of four brothers, namely: Carl Wilhelm (Sir William Siemens,) born at Lenthe April 4, 1823, died in London Nov. 19, 1883; Friedrich, born at Menzendorf in 1825, and Carl, born at Menzendorf in 1829. Werner was educated at the Lubeck Gymnasium. He joined the Prussian artillery in 1834, where his eminent talents soon attracted notice, and having passed through the military schools, he obtained the rank of lieutenant in 1837. While still holding this appointment in the army he applied himself with great zeal to the study of practical chemistry and physical sciences, and became the inventor of the process of electro-gilding, the differential governor and the electro-automatic recording telegraph, for all of which patents were granted him in Prussia. As member of a commission of the Prussian General Staff for the introduction of the electric telegraph system in place of the optical telegraphs, he proposed, in 1847, the application of subterranean conductors, insulated by gutta-percha. Successful experimental lines were operated, the wires of which were coated with gutta-percha by means of a press invented by him for that purpose. The press is still used in the manufacture of cables. With the help of these insulated wires he first succeeded, with the assistance of Prof. Himley, in firing submarine mines by electric ignition in the spring of 1848. These mines were designed for the protection of the harbor of Kiel from the Danish fleet. In the same year he directed the construction of the first great telegraph line in Germany, between Berlin and Frankfort-on-the-Main, and in the following year planned the subterranean line between Berlin and Cologne.

Dr. Siemens left the government service in 1850, and subsequently devoted himself exclusively to scientific studies and private enterprises. In 1847 he had already laid the foundation of the telegraph manufactory conducted by him under the firm name of Siemens & Halske in Berlin, the celebrated establishment which was destined to become, and at present is, one of the chief centers for the application of electricity to the industrial arts. Its world-wide reputation, acquired within a short time, led him to open branch works in London and St. Petersburg, which soon developed into large independent concerns under the management of his younger brothers, Wilhelm and Carl.

Dr. Siemens' personal achievements are to be found in the fields of science as well as in the technical arts. His scientific merits induced the University of Berlin to confer on him the degree of Doctor of Philosophy, *honoris causa*, in 1860. He was honored by admission to membership in the Academy of Sciences in Berlin in 1874, and subsequently in many other academies and societies. Among his many and varied achievements in matters relating to science and technical arts may be mentioned as particularly noteworthy, the invention and practical application of a standard unit of resistance known as the Siemens unit, the development of methods for testing underground and submarine cables and of determining the position of faults, the invention of polarized relays, of the so-called Siemens armature, and of the dynamo-electric machine, the principle of which he published first at the meeting of the Berlin Academy of Sciences on January 17, 1867, the electric railway, and of numerous other appliances, including the pneumatic dispatch tube system, and the Siemens alcohol-ometer for registering the quantity of absolute alcohol contained in any alcoholic liquid passing through the instrument.

Dr. Siemens has been appointed a member of the Prussian Order "Pour le Merite," and has become the recipient of many other distinctions and honors. The German emperor created him a noble He is honorary member of the English Institution of Electrical Engineers and is corresponding secretary for Germany.

His many papers read before scientific societies up to 1881 were published in book form, "Gesammete Abhandlungen und Vortraege," published in Berlin by Julius Springer in 1881.

SIEMENS.

Siemens, Sir William (christened Carl Wilhelm); born at Lenthe in Hanover, April 4, 1823; died in London November 19, 1883. He was educated in the Polytechnic School of Magdeburg and the University of Goettingen. He visited England at the age of 19, to introduce a process of electro-plating, which he had jointly invented with his brother Werner. He subsequently returned to Germany and entered as a pupil the engineering works of Count Stolberg at Magdeburg. In 1844 he went again to England to introduce a new invention of his brother Werner, the differential governor for steam engines. He then made England his home, and in 1859 became a naturalized British subject. In 1851 he established himself as an engineer; he worked mainly in two departments, in the application of heat and the application of electricity. He gained great reputation in both fields. The scientific papers which he published from time to time would have alone sufficed to establish his reputation. He was elected in 1862 to membership in the Royal Society and later he became president of the Institute of Mechanical Engineers, the Society of Telegraphic Engineers, the Iron and Steel Institute and the British Association. He was given honorary degrees by the universities of Oxford, Glasgow, Dublin and Wuertzburg. He was knighted by the Queen in 1881. Siemens originated a great number of valuable inventions. Among others he introduced in 1856 the regenerative furnace, the idea of his brother Friedrich, with whom William had associated himself. Siemens was a strong believer in gaseous fuel, and he anticipated that its use would in time supersede that of coal for domestic and industrial purposes, cheap gas being supplied either from works or directly from the pit. One of his last inventions was a house grate, in which to burn gas and coke. This combustion he regarded as a possible cure for city smoke. Another of his inventions is the Siemens electric furnace, in which the intensely hot atmosphere of the electric arc between carbon points melts refractory metals. He also invented a water-meter, an electro-thermometer, a pyrometer, an attraction-meter, and a bathometer, by which the depths of the sea can be found without a sounding line.

A number of his most valuable papers were published under the title, "Einige Wissenschaftlich-Technische Fragen der Gegenwart," issued in Berlin by Julius Springer, 1879.

DANIELL.

Daniell, John Frederick, born at London, March 12, 1790; died in London March 13, 1845. Daniell received from his father, a barrister, an excellent classical education. He displayed from his early years a great liking for natural science. He studied chemistry, and started, in 1816, with Professor Brande, the *Quarterly Journal of Science and Art*. In 1823 he published his meteorological essays. In 1831 he was appointed first professor of chemistry at King's College. During the succeeding years he was engaged in investigations of heat and electricity. In 1832 he received the Rumford medal of the Royal Society. In 1837 he was awarded the Copley medal for his invention of the sulphate of copper battery, which bears his name. In 1842 he received the Royal medal. He is the only person who ever received all three medals in the gift of the Royal Society. The Daniell cell is still used as a standard of electromotive force, and was at the time of the invention a great improvement over other primary batteries. The name Daniell was formerly used for the practical unit of electromotive force, being equal to the electromotive force of one Daniell cell. This name has become obsolete now, and is replaced by the volt, which is equal to .926 standard Daniell cell.

JACOBI.

Jacobi, Moritz Hermann von, born at Potsdam September 21, 1801; died at St. Petersburg, March 10, 1874. Jacobi received a good common school education. At the age of 28 he went to Russia, and soon attracted attention by his researches in physics. He invented electrotyping simultaneously with Thomas Spencer, in Liverpool, in 1837. In 1839 Jacobi first succeeded in propelling a boat on the river Neva at St. Petersburg by means of a galvanic battery and an electro-magnetic motor. His motor was constructed after the Ritchie principle, and consisted of four stationary and four movable electro-magnets arranged around a horizontal shaft, with a paddle wheel on each end. The battery consisted of 64 zinc-platinum cells. This scientific triumph was, however, not crowned by commercial success, for the simple reason that primary battery power then was and still is too expensive. Jacobi laid down the fundamental theories of electric motors. He proposed practical units of resistance and current strength. (See Weber.) He constructed electric telegraphs in St. Petersburg; the most extensive line being 18 miles in length between two of the imperial residences. He conducted many experiments on these lines, and made the important discovery that by using the earth as a "return" the circuit was completed. In 1840 he published "Die Galvanoplastik" (The Art of Electrotyping), a work which gained him admittance to the Imperial Academy at St. Petersburg. His principal works were published in the "Poggendorff's Annalen" from 1834 to 1857. The most important are: "Applications of Electro-Magnetism," "The Phenomena of Induction in the Voltaic File," "The Laws of Electro-Magnets," ' Reports on the Application of Galvanism to Electrotyping," "The Ignition of Gunpowder," etc.

A Review of Modern Electrical Theories.[1]

By Prof. Wm. A. Anthony.

The general phenomena of electricity are familiar to us all. As children we learned of the attraction and repulsion of electrostatic charges, of condensers, of insulators and conductors, of electric currents and electro-magnets, of telegraphs, and electric fire alarms and electric bells, of the heating of conductors, and even electric lights. We have long been familiar with the effect of the current on a magnetic needle, and with the attraction and repulsion of currents for each other. We have seen that these effects are manifested at a distance from the conductors which carry the currents, and we have been willing to believe that the distances at which these phenomena could be recognized were limited only by the want of sensitiveness of the apparatus through which the effects were manifested. Probably not many of us stop to think *how* these effects were brought about. We were content with a general statement of the relations of the phenomena, or, at least, with the determination of the direction and intensity of the forces due to a given conformation of current. We talked of the attractions and repulsions as action across space, and if we thought of them at all as requiring any mechanism through which to act, we still felt satisfied when we had discovered and formulated the laws that govern the action of these forces.

It did not matter to us that attraction across empty space was unthinkable; it was enough that action took place and that we could measure and, to a certain extent, control it. We constructed instruments and computed forces acting under certain conditions; we multiplied experiments, and thought we had developed a vast science. But there have not been wanting, even among the earlier philosophers, some who could not feel satisfied with the idea of action at a distance. Experience gives no clue to any explanation of action of one body upon another at a distance, except through some intervening mechanism, and if we find cases where such intervening mechanism is not apparent, to say that in these cases action at a distance is taking place, is only to say that the action is unexplained.

Gravity acts upon the distant planets and, we believe, upon the most distant stars; but it is not enough to say that gravity acts, that it decreases as the square of the distance increases; we want to know *how* it acts. By what means or through what medium does our earth reach out

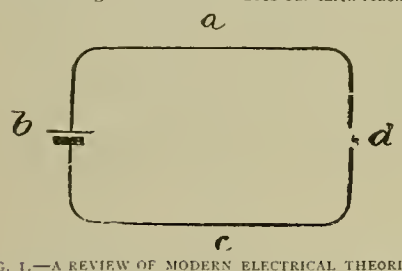


FIG. 1.—A REVIEW OF MODERN ELECTRICAL THEORIES.

to the distant planets and affect their movements? These are the questions that the dissatisfied few have asked in the past, and to-day it is not the few but the many who would be glad to have the question answered. Faraday early taught us that the mere statement of the law of electrical attraction or repulsion was no explanation, and he sought the explanation in the action in the intervening medium. He demonstrated by experiments, that have become classic, that the effect of induction depends upon the nature of the medium intervening between the conductors; a demonstration that here, at least, the intervening medium took part in the action and helped to determine the result. Magnetic and electro-magnetic phenomena were to Faraday also effects propagated through the medium; and Maxwell, following Faraday's work, subjected the whole matter to a searching mathematical analysis. It was necessary, in order to complete the theory, to assume the existence of a medium in which the forces were exerted; but as a medium had already been assumed to account for the phenomena of light, it would hardly be scientific to assume another to account for electrical phenomena But would not one medium suffice for electrical and optical phenomena as well? Maxwell showed how the question of the identity of the two media could be tested, and our modern views of electricity are mainly the results of his work. What do we *know* of electrical phenomena? We know that pieces of glass and silk rubbed together and then separated attract each other: that the property of attraction can be imparted to metals if they are insulated; that if two such masses of metal he connected by a wire the power of attracting each other disappears, and at the same time the wire is warmed and for an instant exerts magnetic force at right angles with the wire. Numerous other facts we know, but these will suffice as illustrations of the phenomena. When a metal conductor is discharged by touching it with a wire, we say the wire carries a current, and we have been accustomed to ascribe the heating and magnetic effects to that current. We have looked upon the thing, whatever it is, that takes place in the wire as the origin of all that takes place around it. The current warms the wire, and it confers upon it the property of acting upon magnetic needles; but *how* does it act? We cannot conceive of the action of that wire on that needle, except through something extending from the wire to the needle, through which the wire can exert a push or a pull. All around that wire the needle is affected; at considerable distances the effect can be exhibited, and we believe it is only want of delicacy of our apparatus that prevents our discovering it at the greatest distances. If the wire acts, it acts through a medium in which it creates a disturbance, and the disturbance in turn acts upon the magnetic needle. But are we sure that the action begins with the wire? Is it not possible that the action begins with the medium, and that the wire merely separates portions of the medium and so permits action that could not otherwise take place? Maxwell has proposed a mechanical illustration of the action taking place in space when electrical phenomena occur, and Fleming and Lodge have elaborated it and brought it within the reach of non-mathematical readers. Let us suppose all space to be filled with wheels connected by idle wheels in such a way that when one turns all must turn in the same direction, except that the elasticity of the system permits a small movement of one wheel before the others in the vicinity begin to move. Electromotive force is then something that tends to turn the wheels. Let *b* in Fig. 1 represent some source of electromotive force; *a* and *c* conductors not forming a closed circuit but having an opening at *d*. The electromotive force at *b* tends to turn the wheels, but so long as the gap exists at *d* the wheels are connected through all space, and the e. m. f. at *b* can effect nothing except to turn the wheels through a small angle until the elastic resistance balances the e. m. f. In the conductor the wheels are not supposed to be rigidly connected. They can turn by slipping on each other, and the wheels in space may turn by slipping on the wheels in the conductor; hence, as the ends of *a* and *c* approach each other, the connection between the wheels within the inclosure and those of outside space becomes smaller and smaller, and when the conductors touch, there is no longer anything to prevent the wheels within from turning, and they begin to spin in obedience to the e. m. f. at *b*. The conductor is heated by the friction due to the slip of the wheels around and within it. The spinning of the wheels constitutes the magnetic forces if we assume the wheels, originally spherical, to become flattened spheroids by the spinning, and to be forced to remain in contact at their poles. Assume the wheels to have inertia, and it will require time for them to reach their full velocity, and the time will be greater as the number of wheels is greater, that is, as the magnetic forces developed are greater. On the other hand, the wheels will not at once stop if the electromotive force is removed, and if the conductor be broken at some point, allowing the rapidly spinning wheels inclosed by it to come in gear at that point with the stationary outside wheels, there will be, for a brief time, until the moving wheels can be brought to rest, a clashing and disruptive action known as the extra spark.

I have spoken of the heating of the conductor as due simply to the friction of the spinning wheels upon the wheels within the conductor. The greater the friction the greater the motion imparted to the wheels within the conductors, and the greater the heating. The less the friction the less the heat, and if there were a substance whose wheels could revolve among themselves and against the wheels of space without friction, such substance would form a perfect conductor which would offer no resistance to the motion of the wheels in the space inclosed by it, and however rapidly those wheels might revolve they would have no influence to produce motion within such a conductor. We are led then, to this, that a perfect conductor, instead of being a substance in which any e. m. f. produces an infinite flow of electricity, may be a substance in which no effect whatever is produced.

I do not present this as representing the real activities involved in electrical phenomena, or as a theory by which all electrical phenomena may be explained. I give it as bringing prominently into view the activities in the medium surrounding the conductor; whereas, the language in which we usually describe electrical phenomena points to the conductor itself as the seat of the electrical forces. Whatever our theory, we know that something does take place in the medium that surrounds the conductor. We know that were a heavy current to flow through a conductor in the most distant part of this room a delicate needle here on the table would show that a magnetic field was produced here. We are certain that magnetic lines of force from the electric currents on our streets, whether overhead or underground, permeate this room, and traverse our bodies even, though we have no sense through which we can become directly conscious of them. Take in your hands two wires connected to the poles of a battery or dynamo and touch their ends together. You see a flash of light, the wires become warm, they attract iron filings; coiled into a spiral they will attract with great force large masses of iron; two such spirals will attract or repel one another. What more natural than to say: Here in the wire is a new activity which warms it and confers upon it magnetic properties? What more natural than to forget or fail altogether to recognize the activities in the space around; activities that do not impress any of our senses; that do not wrench our arms, or burn our flesh, or blind our eyes; and yet it is well to fix our attention for a while upon the space that the conductor incloses, and recognize the fact which the little delicate needle demonstrates to us, that something else is going on in that space, something quite as important, perhaps more important, than that which takes place in the conductor?

Whatever the magnetic forces are, we know they cannot be called into existence instantaneously. Time must always elapse before the full effect of an electric current is felt, and the greater the forces developed the longer are they in reaching the maximum. Moreover, the current in the wire cannot be at once developed; it keeps pace with the magnetic force and reaches a maximum only when the magnetic forces reach a maximum. This is exactly what would follow if magnetic forces result from the setting in motion of wheels possessing inertia. Whatever magnetic forces may be, they begin and end like the motions of massive bodies.

Continuing our hypothesis, an electromotive force would be anything that tends to set the wheels in motion. The wheels are set in motion if a limited number acted upon by the e. m. f. are separated by a conductor from the other wheels of space; but, even if they are not separated, that is, if the conductor does not form a closed circuit, the wheels are rotated through a small angle depending on the elasticity of the wheel work. This displacement constitutes an electrical charge, the tendency of the wheel work to spring back is *difference of potential*, and this difference of potential is maintained by the e. m. f. Here allow me to call attention to the distinction between difference of potential and e. m. f. I often see statements that indicate that the distinction is not clearly kept in view. In that excellent little volume, the "Dictionary of Electrical Terms," the statement occurs that electromotive force is *due to* difference of potential It should be rather difference of potential is due to e. m. f. Difference of potential is *an* electromotive force, but not all electromotive forces are difference of potential; and, furthermore, I can think of no case of difference of potential that does not owe its existence to some other electromotive force, not difference of potential. Difference of potential is a moving force acting from within. Electromotive force acts from without. Difference of potential results from a changed electrical distribution, an electric strain, and represents the tendency to return to the state of equilibrium. Electromotive force is the something from without that produces the electric strain. Consider our wheelwork illustration. I may seize a wheel here and turn it, but I can only turn it through a small angle before the elastic forces, brought into play by the distortion, balance the force that I am able to exert. My force is electromotive force, the elastic forces are difference of potential. Let Fig. 2 represent a voltaic cell with its copper and zinc plates, and dilute acid; we know that something takes place by which the copper becomes positive and the zinc negative, and, if the copper and zinc be joined by a wire, electricity is said to flow from the copper to the zinc through the wire, and from zinc to copper through the liquid. The flow through the liquid used to be explained by assuming the zinc to be positive and the copper negative within the liquid; just the reverse of what we find without. But connect the copper to the zinc by a wire under the liquid, the current flows through the wire from the copper to the zinc. The copper, therefore, is not negative, but everywhere positive. Then why does the current set from the zinc to the copper through the liquid? Because there is an electromotive force, not difference of potential, mind you, for the difference of potential tends to cause a flow the other way, but a something that forces the current through the liquid against the electric pressure. The cell is an electric pump that pumps electricity from the zinc into the copper until the pressure becomes so great the pump stops. Open a passage from the copper to the zinc by connecting the two by means of a metallic wire, the electricity flows and relieves the pressure, the pump begins to work and so maintains a continuous flow. No, e. m. f. is not difference of potential, although difference of potential is e. m. f. It is even possible to produce an electric current without any difference of potential whatever in any part of the circuit, just as it is

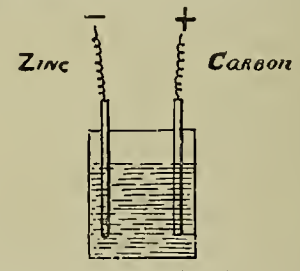


FIG. 2.—A REVIEW OF MODERN ELECTRICAL THEORIES.

possible to produce a flow of fluid without any difference of pressure.

Whatever difference of potential may be, it behaves like a force developed by an elastic displacement in a solid body. Whatever magnetic forces may be, they behave as though produced by the motions of inert masses. An electromotive force, suddenly brought to bear at a given point, has to overcome not only the elastic force but the magnetic inertia. In other words, an electromotive force, tending to produce current, immediately develops a difference of potential against which it must act, and also develops magnetic forces which retard its action; so a *fluid-moving force* meets opposition in the elastic force of the fluid and in the inertia of its particles. But the effect of any such force is propagated through the medium with a finite velocity expressed by the well-known formula,

$$V\sqrt{\frac{E}{D}}$$

Electric displacements ought, therefore, to be propagated with a finite velocity which should have some relation to the ratio between the electrostatic effects, analogous to elastic displacements, and the electro-magnetic effects analogous to the effects of moving masses. You all know that it is shown that this velocity is expressed by the ratio of the magnitudes of the electro-magnetic and electrostatic units quantity, and you know also that determinations of this ratio show it to be the velocity of light. This determination gave a very strong support to Maxwell's electro-magnetic theory of light, and, coupled with the fact that observations, so far as they went, indicated that magnetic effects are propagated from the sun to the earth with the same velocity as light, made the theory at least extremely plausible. But within two years the wonderful experiments of Hertz have demonstrated beyond question that electro-magnetic waves travel through space from every source of alternating currents or potentials, and that the waves travel with the velocity of light. In this city there are, I suppose, many alternating current systems. When we think of these in action we are apt to think only of the activity in the conductors of the machines, the lines, the transformers, the lamps, and yet we know that in all the space around there is activity. Waves are chasing each other through this room, through our streets, our houses, our offices. They are everywhere present. We are bathed in this agitated medium every moment, and yet we live, and not only live, but are totally unconscious of

[1] Read before the American Institute of Electrical Engineers, New York, January 21, 1890.

the activity that surrounds us; no sense responds to the wave motion that fills this space. And yet, when these waves become short enough and frequent enough, they do affect our sense of vision and a vast array of phenomena that otherwise would have had no existence for us, are made known to us through this special sense. But the eye only responds to waves of $\frac{1}{76000}$ to $\frac{1}{37000}$ of an inch in length, while the length of the waves emitted by one of our alternating current systems is 600 miles. The waves that affect the eye must occur at the inconceivable rate of at least 400 millions of millions per second, while less than 300 waves per second are emitted from our alternating systems. These waves come very far short of the number necessary to affect any of our senses; but we have been able to demonstrate their existence, at least we have been able to show that something possessing all the characteristics of wave motion exists in the space around a source of alternating currents or potentials. It is something to know that waves of such enormously different lengths and frequencies exist in the medium that is agitated by waves of light. It is something to understand that our sources of alternating currents are centers of radiant energy, differing from light only in wave length; and since we have begun to appreciate this fact, we have often asked ourselves the question: Can the rate of alternation be increased until the whole apparatus shall glow with light? Although the enormous rapidity required seems to render this direct solution impossible, it seems to me there must be a way to obtain the light we want without all this waste of energy. I cannot believe it will always be necessary to develop waves of all lengths from many miles down to a hundred-thousandth of an inch, in order to obtain the narrow range of wave length by which we see. I do not know of any practical way of obtaining the few wave lengths that constitute light without, at the same time, producing the others, but it *is* done The glow-worms do it, the fire flies do it, the lantern beetles do it, and I believe the time is coming when man can do it. Instead of getting 10 16-candle lamps per horse-power, we ought to get 200. I don't know how it is to be done. I don't expect we are going to make alternating machines to produce 500 millions of millions of alternations per second. But possibly we may solve the problem indirectly by the use of some substance having a special rate of vibration, such as the gases. Possibly we may be able to excite electrically the fluorescent salts. Possibly we may be able to charge and discharge a condenser and take advantage of the oscillatory discharge to set up vibrations of the frequency required. Possibly we may discover the secret of the glowworm and the fire-fly and substitute electric for the insect energy. I know it will take several fire-flies to equal a 16-candle lamp; but it will also take a good many fire-flies to develop a horse power. But although I do not see at present any practical solution of the problem, I repeat, I believe the problem can and will be solved. We are not going on forever burning a coal mine whenever we want a little light. Neither are we going on forever converting the energy of coal into heat when it is mechanical or electrical energy we want. From the very nature of things not more than one-fourth or one-third the heat so produced can be transformed into any other form of energy. The energy of fuel *can* be converted into mechanical energy without first becoming heat. It is so converted in every animal movement. The way exists; let us find it. Find this, and the way to make light only when it is only light we want, and we shall have lengthened the life of our coal deposits five or ten times. The man who solves either one of these problems will be the greatest discoverer of this or any other age. If he gets a broad patent on it, he will have seventeen years of the grandest litigation the world ever saw.

Now I can imagine that some electrician will consider that the first part of this paper dealt with matters that are of no practical consequence in the use of electric currents. Of what practical consequence is it whether force is conveyed to a distance by means of a medium or simply acts at a distance? What does it matter whether electric energy is conveyed by the conductor or through the dielectric? We know how to proportion and dispose our conductors to produce a given effect, and that is enough. But consider what we have learned already of the intimate connection between light and electricity, and I think you will agree that the more we know of the ultimate nature of electricity the nearer we shall be to the solution of the great problem to which I have referred, and the solution of either one of those problems would revolutionize some of the most important industries of the world. May not the solution of at least one of these problems be accomplished and the results exhibited at the great exhibition to be held in New York in 1892? What a wonderful achievement it would be to light all these great buildings without heat, or drive all that vast array of machinery without a fire!

Electricity in Modern Warfare.

In an interesting address before the Franklin Institute on "Electricity in Modern Warfare," Lieutenant Bradley A. Fiske traced the development of this department during the last five years, at the beginning of which time only one war ship was illuminated by electricity. The lecturer referred to the improvements made in electrical devices. He told of submarine mines and the Spar torpedo. In the case of the Lay torpedo, he was of the opinion that little improvement had been made. The Simms-Edison and Halpine-Savage, on the other hand, are much more effective to-day, he thought, than they were a few years ago. He next took up the military telegraph service, balloon observation, and balloon propulsion. Among the more recent applications of electricity to warfare, Lieut. Fiske spoke of the hauling of heavy guns by electric motors, electric ammunition hoists, and electric motors as auxiliary engines. Firing guns by electricity he considered a great advantage over the old system, if for no other reason than that the piece was fired at the instant the button was pressed. This obviated the delay incident to the lanyard and the primer, between the actual pulling of the lanyard and the discharge. No subject of the evening was of more interest than that which had to do with electric communication between ships at sea. In the development of this practice the lecturer had taken a prominent part. Recently experiments on this subject have been carried on extensively at the Brooklyn navy yard. In these experiments a large dynamo was used as a source of power, and in one case the crüiser Atlanta was converted into the largest electric magnet known, being wrapped with heavy wire through which the dynamo current was sent, while the iron tug Nina was made a receiver, she being wrapped with fine wire having a telephone in circuit.

Where To Get The News.

The substantial agreement between the two items given below is so marked that they are presented in parallel columns. The paragraph in the first column appeared in the WESTERN ELECTRICIAN of December 28, 1889, and that in the second column in the New York *Electrical Review* of January 25, 1890:

In an entertainment given at Englewood, Ill., a few nights ago, a novel use of incandescent lamps was made. Several young ladies gave a drill in military costume. Their helmets were surmounted with three incandescent lights, with red, white and blue globes. In certain parts of the drill, the lamps were suddenly illuminated and the effect was striking indeed. The details of the installation, which was in charge of Chas. T. Page of the Westinghouse station in Englewood, were extremely simple. A converter was placed on the outside of the building in which the hall was located. The secondary wires ran under the floor to brass plates, about three inches square, arranged in twos on the stage floor. From the lamps on the young ladies' helmets, concealed wires ran down to little brass plates in the heels of the shoes. After concluding a series of evolutions each young lady would come to a stand in the front of the stage, and plant her heels firmly on the plate on the stage. The lights would flash up, and contribute greatly to the general effect. —WESTERN ELECTRICIAN, December 28, 1889.

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Electric Wires in New York City.

The war on electric companies in New York has proven an expensive pastime to the tax-payers, Commissioner Gilroy of the Board of Public works says the city has spent $46,000 during the last year and if the work is continued on the same scale it will require an expenditure of three times that sum this year. He is anxious to have the companies do the work themselves hereafter, and accordingly held a conference recently with Commissioners Hess and Gibbens, and Expert Wheeler of the Board of Electrical Control, Expert Jones of the Department of Public Works, Superintendent Humstone of the Western Union Telegraph company, Superintendent J. H. Emerick of the Postal Telegraph company, and W. H. Eckert, General Manager of the Metropolitan Telephone company. Expert Wheeler said that all the wires in the streets where subways were built should come down, and advised the companies to combine their interests in some way so as to remove all unnecessary wires and poles on side streets. He called particular attention to the wires of the Western Union company on Seventh avenue, from Eleventh Street to Fifty-ninth street, and suggested that they ought to go into the Sixth avenue subway. Superintendent Humstone said it would be a great inconvenience if the company had to build subsidiary lines to connect with the Sixth avenue subway. He added that he would submit to the Board of Electrical Control a report, in which it would be stated whether his company would take down its wires, or let the department go ahead with the work. If it was decided that the company should take them down, dates would be submitted. The representatives of the other companies also agreed to submit reports to the Board of Electrical Control at an early date.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 25.—The announcement that Commissioner Gibbens of the Board of Electrical Control had resigned, caused considerable surprise in local political circles as well as among electrical concerns, and various reasons were suggested for the action. It was believed that Mayor Grant's refusal to have anything further to do with the proceedings of the board as long as Gibbens was the guiding spirit, together with the terrible scoring that the daily papers have given the board since its proceedings have been exposed, had led to this action, but now it appears that the ex-commissioner had another object in view. It is claimed that his friends have been endeavoring to secure his appointment under the act providing for a State Board of Electrical Control, and that in order to secure him in this position he was forced to resign from the New York board before it was abolished and save the humiliation of being thrown out of office. The New York papers have done the public a great service in exposing the work of the board. It is confidently hoped by the electrical concerns of the city as well as those interested in the illumination of the streets, that no one who has had anything to do with the present board shall be appointed on the State Commission. The present commissioners have shown themselves thoroughly incompetent to deal with the subject aside from the fact that the people have lost confidence in them.

It is thought that the city will again be thoroughly lighted in the course of sixty days as the electric light companies are putting forth every effort to place cables in the subways The very large call for wires and cables is so great that several wire companies are running double forces in order to fill their contracts,

A complimentary dinner was tendered to E. H. Johnson at the Hoffman House, Monday evening, by H. McL. Harding and J. L. Barclay of Chicago. The occasion was the resignation of Mr. Johnson as president of the Sprague company. Messrs. Insull, Vail, Sprague, Muir, Hobson, Wise, Frank Johnson, S. Dana Greene, C. T. Hutchinson, H. W. Blake, T. C. Martin and W. H. Temple responded to interesting toasts.

Dr. A. D. Rockwell of the State Commission to test the efficiency of the electrical killing machines, is another enthusiast for this mode of execution. The commission has been killing cows, dogs, bulls and horses.

The annual meeting of the American Copper Manufacturers' association followed by a banquet, was successful in bringing together representative men, but unlike former meetings there was no very serious question to be discussed and the last year's schedule of prices and terms will be continued for the present year. The officers elected were: President George A. Pope of the Baltimore Copper Smelting & Rolling company; vice-president, Joshua Hendricks, of Hendricks Bros. of New York; secretary and treasurer, William H. Mathews of the New Bedford company. Other gentlemen present were A. A. Cowles of the Ansonia Brass & Copper company, S. G. Snow, Boston; H. F. Bassett, Taunton; William A. Duval, Brooklyn; E. T. Dravo, Pittsburgh; L. H. Jones, Detroit; J. S. Hazleton, Rome, N. Y.; E. D. Tuttle, Chicago; L. Lewisohn, N. Y., and Thos. Wallace of Ansonia, Conn.

The directors of the New England Telephone & Telegraph company have just declared a dividend of $1.25 per share payable February 15.

Dr. Henry A. Rowland, director of the Physical Laboratory of the Johns Hopkins University, has been made a member of the Royal Society, London. The only other American members are Prof. Dana of New Haven and Dr. Simon Newcomb of John Hopkins. Prof. Rowland was elected a member in recognition of his work in the electrical field and the aid which he has given to the progress of physics in America and other countries.

The first meeting of 1890 of the Stevens Engineering Society was held last Friday and a paper on "Electroplating" was read by Carl Graf, illustrated with experiments. A paper on "Steam Indicators" was also read by E. H. Whitlock,

The recent report that a Havana tanner had discovered an electric process for tanniog hides is doubted by merchants of this city. Jackson S. Shultz, a leading leather merchant, said: "It really, so far as is actually known, amounts to nothing. In the Worms-Bale process, which is probably the parent of the alleged Havana discovery, the motion or agitation of the tub was sufficient to cause the rapidity of the tanning process without the use of any electricity. All this hue and cry about electrical tanning is about on a par with electrical sugar refining. I have studied the matter, and I say that the other agents used, together with the agitation of the hides and liquids, will produce the same results with or without electricity. The Frenchmen wished to sell me their patent for this country, and my offer was that if they would come here and demonstrate to any of us that electricity would produce other results than the tanning acids naturally produced when continuously agitated, we would take the patent at their price. But they declined to come here. The plan is not feasible in any way, for the immense amount of power required to agitate the tubs or drums would more than offset any saving in time. Now, as to the Havana discoverer. There is but one tanner in Havana, and he is not likely to make any startling discoveries. I take no stock in it. The scheme is visionary. So little is actually known of the uses of electricity that anything can be claimed through its agency, but business men want actual demonstration before they invest their capital. The whole thing is right here. The same results will be attained under the same conditions, with or without the use of electricity."

The storm interfered with western telegraphic communication, the Western Union company at one time having only one line operating between New York and San Francisco.

The general public does not appreciate the influence of the telegraph on business of the country, but there are many men in this city who during the last week have had this important point impressed on them forcibly. The tickers in the offices of members of the stock exchange which formerly belonged to the Commercial Telegram company started up yesterday morning, after being silent for two days, with this message: "This instrument will hereafter be operated by the New York Quotation company, and will distribute quotations exclusively to members of the New York Stock Exchange."

This is in accordance with an arrangement by which the Stock Exchange comes into the control of the plant, instruments, etc., of the Commercial Telegram company. The gold and stock tickers will also deliver quotations, but they will be sent out several minutes later than the Commercial.

A bill has been introduced in the assembly at Albany providing that "the rental of ducts for the reception of wires under ground in the main subway and for subsidiary or distributing ducts and wires shall be fixed by the Board of Commissioners of the Sinking Fund." Of course, this refers to the ducts, wires and subways in New York city.

The mystery regarding the two fires which occurred recently in the rooms of the New York Telegraph club, is not yet solved, but there is little doubt that both fires were started wilfully. The last one began in front of the bookcases, and the spot on the floor is even now redolent of kerosene. Many of the articles which were destroyed, such as the portrait of Prof. Morse and old books relating to the craft, cannot be replaced. Some of these were presented to the club by J. D. Reid, and others by Andrew Carnegie, "a fellow craftsman" as he signed himself. He used to be a messenger boy. Their money loss the club members hope to more than make up from the proceeds of a big reception which they are going to give in the Central Opera House, on Sixty-seventh street, on Feb. 3.

W. H. T.

Kansas City, Mo.

KANSAS CITY, Mo., Jan. 25.—All the talk in electrical circles now relates to the coming convention. The committees in charge of the details of the arrangements are meeting almost daily. Now that President Weeks has fully recovered from la grippe, he is devoting all his time to the meeting. He says every mail brings him assurances of the success of the convention in every way.

The recovery is announced also of Paul Bossart, electrical agent, and of T. F. Clohesy, Inter-state company manager, from the same disease.

Charles Rusling of the Thomson-Houston company, has returned from an eastern trip. He will remain here as the company's agent.

J. M. Kent is now superintendent of the Inter-state company. Directors have been elected as follows: Kansas City Electric Light company—W. B Grimes, J. S. Chick, J. J. North, J. Scammon, F. K. Hoover, O. H. Dean, F. N. Chick, E. R. Weeks, W. B. Grimes, Jr.; Edison Electric Light company—W. B. Grimes, F. H. Hoover, J. L. Chick, O. H. Deao, W. B. Grimes, Jr., W. P. Hicks, J. H. North, E. R. Weeks. Inter-state Electric company—Wash Adams, E. P. Brook, W. H. Winants, Winfield Freeman, J. D. Cruse, Robert Moody and F. K. Moody.

At a meeting of property holders along the line of the proposed Kansas City Suburban railway last week, E. J. Lawless, the engineer, and H. M. Merriwether, who is most active in advancing the scheme, explained the details regarding the route to be traversed, length of road, grades, equipments, etc. The franchise was granted last June. The capital stock is $100,000. The proposed route is from the present terminus of the Troost avenue cable road to Forest Hill cemetery, on the Waldo Park race track, a distance of about five miles. It is the intention to make this road an electric line. It is now proposed to build a branch line to Albion, a settlement northeast of Forest Hill cemetery, by either Davis and Prospect avenues, or straight across from Troost avenue to Albion, over a finely built country road. There will also be a branch line extending from Troost avenue into Forest Hill cemetery, through the main avenue of the cemetery, if the trustees will permit.

The actual beginning of the road is at Grand and Fussell avenues, the latter being the same as Thirty-third street. This branch will receive passengers from the Grand avenue and Holmes street cars and at Troost, from the Troost cars. Transfer arrangements have been concluded with President Smith of the Kansas City Cable company. The new electric line will charge a fare of 10 cents. The stockholders say that the cost of constructing this electric line, including equipment and everything, will not exceed $25,000 a mile, while the average cost of building a cable road track alone is $50,000.

William Mather was arrested in St Joseph this week. A resident of this city offered bond before Justice Long, by telephone. Justice Long was called to the telephone by St. Joseph, and asked if he would accept bail from that distance. The justice said that he would if the sheriff of Buchanan county should approve it. The sheriff said he would approve the bond, and Justice Long accepted it, and ordered Mather's release.

The annual meeting of the Missouri & Kansas Telephone company was held last week. The following board of directors was elected: J. S. Chick, W. B. Clarke, T. A. Walker of St. Joseph; J. R. Mulvane and T. B. Sweet of Topeka; George Albree and C. D. Crandall of Chicago; John E. Hudson of Boston; E. E. Cook of Davenport, Ia. The directors re-elected the officers. The company has in use 7,000 telephones, 2,800 of which are in Kansas City.

The Ivanhoe Park Electric Railway company is circulating a petition among property owners, preparatory to extending its line on Seventeenth street from Vine to Wyandotte street, and on Wyandotte from Seventeenth to Second. As far as the petition has been circulated, there has not been one opposing property holder found.

Alexander Graham Bell arrived in this city last Saturday from Denver, Colo., en route to his home in Washington. He was accompanied by his wife. "I have had nothing to do with telephones for three or four years," said he to the WESTERN ELECTRICIAN representative, "and I am now engaged in a different research. My interest now in the telephone company which bears my name is merely that of a stockholder. The use of the telephone has increased from year to year since it was first placed upon the market. I do not know the yearly percentage of increase, but telephones are universally used. It is hard to get away from them. I remember an incident which happened to me a few years ago while traveling in Italy. My wife and I were crossing Italy, and one afternoon we stopped at a small town in the interior. We had been in the hotel but a few minutes, and I was congratulating myself on having found one place where telephones were not known, when a waiter entered my room with a card. It was the card of the manager of the town telephone exchange which, it seems, had its office in that very hotel. For the last three years I have devoted my attention to the subject of deaf mutes' intermarriage and its results upon their offspring."

Judge O. L. Miller, at last Friday's sitting of the Wyandotte county, Kan., District Court, overruled a demurrer to the petition of the Kansas City, Mo., Electric Light company asking a perpetual injunction to prevent the city authorities from removing its poles and wires in Kansas City, Kan. This is the probable culmination in the Wyandotte District court of a war against the Kansas City Electric Light company, waged by the city at the instigation of the Consolidated Electric Light company, a rival corporation. The defendant's attorney excepted to the rulings of the court, and the case will be taken to the Supreme court. Some time ago the council adopted a resolution instructing the city engineer to notify the Kansas City Electric Light company to remove its poles and wires from State Line street within a certain period, or they would be torn down. The company at once instituted proceedings to enjoin the engineer from carrying out the threat contained in the resolution, and a temporary order restraining the city from interfering with or in any manner molesting the company's property until the final determination of the case was granted. The city, aided by the Consolidated Electric Light & Power company, entered a demurrer to the petition denying that the Kansas City, Mo., company had the right to operate in Kansas City, Kan. The Missouri corporation has been operating under a franchise granted the Kawsmouth Electric Light company several years ago, but the city and the Consolidated company have claimed all along that a Kansas corporation had no authority to transfer its vested rights or franchises to a foreign corporation. The demurrer having been overruled by the court, the case will come up next week for hearing on the petition asking for a permanent injunction. Benjamin Freidberg, general manager for the Consolidated Electric Light company, says that the case will be taken to the Supreme court, as the city's line of defence in the case was clearly set forth in the argument on the demurrer.

W. B. Knight, an engineer of this city, has secured a contract to construct an electric railway in Memphis, Tenn., and the work will begin at once. The system is to be thirteen miles in length, and divided into three separate lines, extending south, east and north from a common power house. The engine will be of the Corliss manufacture, and with a capacity of 600 horse power. There will be double tracks laid through all the city streets, while in the suburbs for the present only single tracks will be used. Only ten cars will be used at first, but the plant will have a capacity for double that number. Mr. Knight will build, furnish and equip the line throughout, and in payment will receive $400,000 of the company's bonds. The line will not be completed until July. Mr. Knight is now in New York city on business for the line.

P.

Boston, Mass.

BOSTON, January 24.—I have gleaned some very interesting statistics in regard to the use of gas and electricity in this state, from the fifth annual report of The State Board of Gas and Electric Light commissioners, which was presented to the legislature to-day. In the state there are 75 gas companies, 26 of which have the right to supply both gas and electricity, and 100 electric light and power companies. During the year 7 gas companies have been authorized to engage in electric lighting business, and there were 44 new electric light and power companies and 4 new companies for the manufacture of gas and electricity incorporated. It is estimated from reports received from various sources that there were 107 deaths in the United States in 1889 from inhaling illuminating gas, 30 of which were suicidal. In 18 of the accidental cases the gas was blown out by ignorant persons, in 8 cases death was caused by gas stoves, 1 by a leaky gas pipe and 3 by defective keys, where the gas is turned on at the burner. The average price of gas in the state is $1.4935 per thousand feet, as compared with $1.72 in 1886, $1.66 in 1887 and $1.56 in 1888. While the consumption of gas for private lighting is constantly on the increase its use for street lighting is decreasing each year, electric lights taking its place. During the year the coal gas companies have lost 999 lights. The board says there is a demand for a simple and economical means of testing the candle power and quantity of electricity supplied to consumers. The demand for both gas and electric light is constantly growing, and the advance in electric lighting has been especially noteworthy. The following table shows the number of electric lights of various candle power in use in the state in 1888 and 1889.

	1888.	1889.
16 candle power	52 075	80,075
20 " "	1,200	2 800
15 " "	800	880
2,000 " "	5,846	6 978
1,200 " "	2 757	4,206
1 600 " "	110	130
1,500 " "		35
1,800 " "		40
800 " "		140

Prof. Elihu Thomson delivered an interesting and valuable lecture on "What is Electricity?" at Cabot hall in Lynn on Tuesday evening of this week. The lecture was given under the auspices of the Thomson Scientific club of which Professor Thomson is president, and the club had as its guests the students of the Lynn High school and their friends. Professor Thomson entertained the immense audience for over two hours by a brief review of the theories of electrical action including the now famous discoveries of Dr. Hertz, explaining these thories by blackboard diagrams and experimental demonstrations by mechanical models. This was followed by a repetition of the unique and beautiful experiments which Professor Thomson gave in connection with his exhibit at the Paris exposition last summer, together with many new experi-

ments of the same character, some of which Professor Thomson said were not more than a week old. For all of the experiments an alternating current of 200 volts was used, being taken from the city lighting circuit of 1,000 volts and reduced by a transformer to one-fifth of that amount.

On Wednesday evening of this week the members of the Boston Boot & Shoe club at its monthly dinner at the Parker House in this city, listened to a discussion of the subject, "The Practical Uses of Electricity." The guests and speakers of the evening were Professor Elihu Thomson, Professor Charles R. Cross of the Mass. Institute of Technology, F. S. Hastings of the Edison Electric company, N. Y., President Henry M Whitney of the West End Street Railway company, Boston, and Capt. Eugene Griffin, general manager of the railway department of the Thomson-Houston Electric company. Among other guests were H. A. Pevear, president, and C. A. Coffin, vice-president of the Thomson-Houston Electric company, and vice-president J. N. Smith and general manager H. A. Royce of the Thomson Electric Welding company Capt. Griffin in his speech stated that the reports of the fire marshal for three years showed that in Boston in 1887 only three out of 344 fires here were attributable to electric wires. That in 1888 there were about the same proportion, and that in 1889 only two per cent. of the fires were from electric causes

The report of Fire-marshal Whitcomb of this city upon the investigation which he has made into the circumstances attending the origin of the Thanksgiving day fire, was presented to the Board of Aldermen on Monday night. The document is long, and is accompanied by diagrams of the building and the Electric Time Clock company's circuits. He has been unable to determine the cause of the fire definitely, and there is no adequate proof that it was originated by the electric current. The complete destruction of the building with all its contents, entirely removed all traces of the fire's origin.

The situation of the various parties interested in the city's electric lighting contracts remains unchanged. Neither party has given up the contest. The *Traveler* aptly says, "With the Boston Electric Light company rolling up its coat sleeves for a fight to save its business, and the Suburban Electric Light company contracting to furnish lights at about half price, and Alderman Smith proposing that Boston should do its own electric lighting, there is a probability of considerable excitement before the question is finally settled." The Suburban company has petitioned for the right to erect electric light poles in the city.

The "blue-blood aristocracy" of Commonwealth avenue are not to have the electric lights removed from that avenue without a protest from some very influential citizens. A remonstrance was presented to the aldermen this week by ex-Governor Ames and a long list of other taxpayers and residents on the avenue, asking for the continuance of electric lights.

On Thursday afternoon of this week there was a practical trial of the electric train signal exploited by the Johnston Electric Train Signal company of 620 Atlantic avenue in this city. The trial was made upon a special train on the Revere Beach and Lynn Railroad, and was attended by many prominent railway managers and electrically interested gentlemen from Boston and Lynn.

Geo. Westinghouse, Jr., and family are at the Brunswick in this city. O. H. M.

THE ELECTRIC LIGHT.

A 1,000 light plant will be installed in the Tacoma, Wash., hotel by the United Edison Manufacturing company.

Victoria, Tex., has an electric light system, and most of the business houses of the town are illuminated by arc lights.

At a special election held at St. Charles, Mo., last week, it was voted to incur an indebtedness of $15,000 to establish an electric light plant.

The use of the electrical accumulators at the New York Electric club, which was discontinued about three weeks ago, is to be resumed, it is stated.

The Sun Electric Light company of Chicago has elected the following officers: President, D. P. Perry; secretary and treasurer, H. C. Parmelee; manager, Geo. Rollins.

The Chicago Edison company has closed a contract with the Fairbanks Canning company of Chicago to illuminate its establishment at the stock yards. A plant of 2,600 lights' capacity will be installed.

The Pomeroy & Middleport Electric company, Pomeroy, O., which began operations in October, has already placed its entire arc lighting capacity, and contemplates adding an alternating incandescent plant. E. S. Trussell is the general manager and treasurer of the company.

The Northwestern Electrical Supply & Construction company of Seattle, Wash., has recently furnished the Ellensburg Electric Light & Power company a Thomson-Houston plant. The steam plant, which is of 100-horse power capacity, is furnished by the Ball Engine company of Erie, Pa.

It is expected that an Edison plant will be erected and put in operation in Springfield, Mo., the coming spring or summer. Besides furnishing current for lights the plant will provide the Sprague electric motor cars with power for running cars on the Citizens' railway lines; also power for running light machinery.

The Hudson Electric Light company of Hudson, Mich., started its plant about the first of last month, under a thirty days' trial by the Schuyler company, from which the electrical machinery was purchased. With the exception of some slight delay owing to the blowing out of a hand-hole plate on the boiler, everything has been running with perfect satisfaction.

At a recent meeting of the stockholders of the Chicago Edison company, the following directors were elected: A. F. Seeberger, John B. Drake, Lambert Tree, E. L. Brewster, R. C. Clowry, Byron L. Smith, R. T. Lincoln, J. W. Doane, F. S. Gorton, A. A. Sprague, E. M. Phelps. A president was not elected. J. W. Doane was re-elected vice-president and F. S. Gorton secretary and treasurer.

The contract for lighting the city of Boston with arc lights has been awarded to the Westinghouse Electric company. The contracts call for 653 arc lights, and the entire plant must be running within four months. The Westinghouse Electric company will, in consequence, work day and night to complete the apparatus for this plant. The newly brought out Westinghouse arc light system will be introduced in the plant.

S. W. Trawick of the Excelsior Electric company, Chicago, has recently closed a contract with the city of St. Charles, Mo., to furnish a complete electric light plant. The equipment will consist of three 30-light Excelsior arc machines which will be driven by two Russell engines of 30 and 60-horse power respectively. The plant is to be in operation by May 1st, and will supply at the start 50 double lamps. The new type of Excelsior dynamo will be used.

The Pennsylvania Railroad company, having decided to increase the capacity of the electric lighting plant at its main offices in Fourth street, Philadelphia, has shifted its storage batteries to other commodious quarters in the front of the building, in order to utilize the old battery room in the rear for a Corliss engine, to be used as an auxiliary to the present power plant. The Electric Dynamic company has been awarded the contract for making the necessary alterations in the battery plant, switches, wiring, etc. The system will be changed from 60 to 100 volts, the present capacity of the plant being about trebled. The original wiring by the Electric Dynamic company for 1,200 lights is ample for the additional requirements.

The London *Daily Telegraph* recorded a few days ago the proceedings at the annual meeting of the Metropolitan Electric Supply company, of London, England. The corporation has contracted with the Westinghouse Electric company for central station plants of 50,000 lights' capacity and the first installment of 15,000 lights has been in operation for several months. The central station is situated in Lincoln Inn Fields. Several of the most famous London edifices are lighted from this plant, among others Drury Lane Theater, the Gaiety Theater, Exeter Hall, Terry's Theater, the Royal College of Surgeons, the government record office and the Holborn restaurant. At this meeting, Sir John Pender, the president of the company, stated that from the day the plant had commenced operations, there had never been the least interruption in the system. He emphasized the fact that the company had performed everything which had been promised at the time the contract was made.

Burlington, Ia., is the scene of a controversy between two companies engaged in furnishing electric lights. Some months ago the Burlington Gas Light company obtained a franchise from the city council to erect poles, string wires and operate an electric light plant in the city. A week ago the companies' lamps were lighted for the first time. Now the Burlington Electric Light & Power company, which has been in operation about three years, files a petition for an injunction to restrain the gas company from operating its electric light plant and to declare its lines a nuisance, and to have the poles removed; also to annul its franchise on the ground, among others, that the ordinance granting it had not been approved by a vote of the people. This last is the interesting point in the controversy, as no ordinance granting a franchise by a municipality in this state has ever been submitted to a vote of the people, and should the point be sustained it would operate to annul all franchises granted by municipalities to corporations in this state, that of the plaintiff company included.

THE ELECTRIC MOTOR.

The Electric Railroad company operating between Rochester, N. Y., and Ontario Beach, has elected the following officers: President, Arthur Luetchford; secretary, J. Breck Perkins; treasurer Chauncey C. Woodworth; executive committee, Arthur Luetchford, M. A Verner, J. Breck Perkins, Chauncey C. Woodworth, William C. Barry and John N. Beckley.

An electrical engineer, representing the Edison company, visited St. Joseph, Mo., recently, and conferred with the managers of the Union Street Car company about the enlargement of the power station or its removal to another part of the city. Some change will be made soon, and the nature will probably be decided by the report of the expert who is at present examining the situation.

On January 17th, the Jenney Electric Motor company was incorporated at Indianapolis, Ind., with a capital stock of $35,000. The incorporators are Addison Bybee, Julius F. Pratt, Chas. D. Jenney, and Edwin W. Jenney. This company succeeds to the business of Chas. D. Jenney & Co., and will carry on the manufacture and sale of electric motors and other electrical machinery. The manufacturing will be continued at the present location in Indianapolis, where machinery is being added, and the space more than doubled.

H. B. Priadle, writing in *Building* of the electric motor for domestic purposes, says: The electric motor in its present form is efficient, economical, safe and sure; yet all these advantages would amount to but little were it not for the fact that the range of the adaptability of the motor is so wide. The comparison with a steam plant may perhaps show this clearer. The installation of a steam plant requires heavy foundations, expensive boilers, with their auxiliaries, coal bins, which are a source of heat and dirt. The engine requires the best skilled attendance, and owing to its complicated nature, necessitates repairs to which the electric motor is not subject. The electric motor is complete within itself, requiring no auxiliaries—except the wire for supplying the current—needs but little attention, and runs practically without noise. While there is competition between steam and electricity for isolated plants, there is no direct antagonism between the two, as, with the exception of cases where water power is used, steam is a necessary factor in the generation of the electric current. Electricity, therefore, advocates concentration of steam plants, an arrangement the economy of which cannot be denied, and distribution by means of wires or cables, which has been found by thorough practical trial to be the most economical method yet devised.

Friends of electric railways will be glad to learn that during the recent storm in St. Louis the overhead wire system worked admirably. The *Globe-Democrat* says: "The electric motor system of the Lindell came out of its first snowstorm most creditably. While the Lindell's horse cars on the down-town lines were detained as is usual during the first few hours after the storm, the electric overhead wire extensions operated merrily throughout the afternoon and evening, and were not perceptibly hampered, either in their speed or in the facility with which the plant was handled." This has had much to do with increasing the popularity of the system. In speaking of the projected extensions of the Lindell railroad, the bill for which has passed the council, United States District Attorney George D. Reynolds said: "You can say for me that I am one resident upon Lindell avenue who is in favor of a double track railroad there, and an overhead wire electric outfit besides. Five years from now the very men who are opposing this project will be ashamed to own it. They say the overhead wires will be dangerous to people going to mass before daylight. If the wire is in the middle of the street, and they are able to keep on the sidewalks I guess it won't hurt 'em much. I've got little children to look after, just as well as any of the other residents of the street, but I'm not afraid of their getting hold of the wire. I don't think there's half as much danger of their getting hurt by the electric wire as on those bobtail cars that the boys are so fond of hanging upon. And as for the double tracks, if there are going to be any tracks at all on a street there had better be two."

An electric railroad has been under consideration at Rochester, N. Y., nearly two years, and now the chance for securing the introduction of an electric system is excellent. The re-organized Rochaster City & Brighton Railway company, which controls all the lines in the city, has decided to introduce an electric system and is now endeavoring to reach an agreement with the city as to the restrictions that will be imposed upon it. In its detailed statement to the city council the company says it was found impracticable to introduce the cable and the only means of securing rapid transit, it concluded, was by the adoption of electricity. It continues: "If rapid transit is to be afforded to the people of the city of Rochester, we are satisfied that electricity must be adopted as a motive power for the propulsion of the cars. As is well known, electric railroads are now in operation in nearly every city of importance in this country." The success of the West End company's lines in Boston, the popularity of the Euclid avenue line in Cleveland and the example of Rochester's sister cities—Buffalo, Syracuse Troy, Albany, Binghamton, Ithaca and Brooklyn—are cited in support of the statement that the electric system is the most popular and successful known to street railway managers. What has done more, however, to convince the people of Rochester of the desirability of the change is the operation of the electric road between the city and Ontario Beach. The company proposes to begin work immediately and promises to have forty electric cars in operation before August 1, and to continue the extension of the system until every line in the city is equipped, agreeing to have the entire change made within two years.

THE TELEPHONE.

According to the Rochester, N. Y., *Herald*, the long-distance telephone line has been extended to Baltimore and Washington. A line will also be constructed along the Lehigh Valley road. There are now as many as a dozen long distance telephones in use in Rochester.

An illustration of the necessity of suitable communication with lifeboat stations was given recently off Holyhead, on the Welsh coast, where a vessel was wrecked and eleven people were drowned. It is more than probable that had the coast guards been able to send a message by telegraph or telephone, all the victims might have been saved, for they were carried off one by one by the heavy seas as they became exhausted. The London *Times*, in commenting on the occurrence, says: "It is, indeed, a disgrace to us, as the greatest maritime nation in the world, that not alone the lighthouses of America, but also those of Denmark, Russia, Sweden, Holland and France, are fitted with telegraphs or telephones, yet Great Britain still remains without this aid to live-saving appliances."

THE TELEGRAPH.

A telegram from San Francisco regarding the snowstorm which raged in the West last week says: "The Western Union Telegraph company has a large force of men in the mountains clearing the wires of snow Telegraph lines in some places are entirely buried under the drifts, notwithstanding the wires are strung on poles thirty-five feet high."

The newspaper men sent out by the New York *World* to meet Nellie Bly at San Francisco and escort the fair globe trotter to the metropolis, were snow bound for a time on the way out and learned of an interesting case which served to give them an opportunity to display their philanthropy. The story is briefly told in this telegram: "The saddest feature of this blockade is at Cascade, John Coghlan, a telegraph operator, twenty-eight years old and unmarried, is imprisoned in the station alone, dying of pneumonia. There is a two-mile break in the sheds, and Cascade is in the middle of the break. Eighteen to twenty feet of snow surround the station, and the only person near is a boy, halfway at another station. The rotary plow and crew came from Cascade last night, when Coghlan was very low and suffering intensely. The Nellie Bly escort corps tried to make plain to the railroad men that it was their duty to save Coghlan. Dr. John F. Foulkes of San Francisco, is on our train, and a member of the corps offered to secure his services, and the *World* agreed to pay all expenses of going to the relief of the poor fellow." It was impossible to do anything, however, as there was no one in authority at that point, but the persistent newspaper men succeeded in shaking up the officials of the railroad and the operator was rescued and removed to a place where he could be cared for.

Miscellaneous Notes.

An ordinance is pending before the Chicago city council granting a franchise to the Electro-Motor Fire & Danger Alarm Signal company to operate in Chicago, and use the city's subways. In return the company agrees to allow the city to use its subways for its fire alarm and police telegraph service.

As was stated in the WESTERN ELECTRICIAN of January 11th, an important consolidation of electrical interests took place recently in Pittsburg, Pa. At a joint meeting of the stockholders of the Keystone Construction company, the Marr Construction company and the Washington Carbon company, it was decided to amalgamate the interests of these concerns, and call the new organization the North American Construction company. The consolidation went into effect on January 21st, with head offices in the Westinghouse building, Pittsburg. The officers of the North-American Construction company are James S. Humbird, president; F. S. Marr, vice-president and general manager; H. M. Doubleday, general superintendent, and E. H. Wells, general agent. The company will do exploiting and electric construction both for central stations and railway work; and also build, lease and operate central station plants. The Marr Construction company has been in existence for six years, being originally organized to do the construction work for the Edison Electric company. About four years ago, however, the company commenced to do construction work for the Westinghouse Electric company. The Keystone Construction company was established a few years ago as an adjunct of the Westinghouse Electric company, for which it has done construction work ever since. The Washington Carbon company was organized by J. S. Humbird about a year ago for the purpose of manufacturing carbons for general electric use. The new company employs about 400 men, and has a capital stock of $500,000.

Business Mention.

The Rockford, Ill., Electric Manufacturing company has issued a catalogue describing the Mayo system of electric lighting and transmission of power, with copious illustrations.

The Mitchell-Vance company, New York, manufacturers of gas and electric light fixtures, has issued a circular announcing its withdrawal from the Gas and Electric Light Fixture Manufacturers' association.

Mr. Reid, of the Bishop Gutta Percha & India Rubber Insulating company, says that the factory is just now turning out several miles of cable for the conduits which is insulated with rubber compound and then encased with lead.

The National Carbon company of Cleveland, O., has just issued a handsome calendar which will prove valuable to electric light companies. On the face of the calendar are given the hours of the rising and setting of the sun and moon On the reverse side of the calendar for each month is given the moonlight schedule.

The Eastern Electric Cable company has just installed a new Armington & Sims engine at its works in Boston to run an incandescent machine which supplies light to the factory. The company is exceedingly busy, having been obliged to double the force for night work. It is now manufacturing a cable one million two hundred and forty thousand feet long, which goes to the Pacific Coast. Negotiations are in progress for extensive improvements and a new building which will enable the company to take care of its constantly increasing business.

It is claimed for the Clark automatic safety device that in the event of the wire breaking or becoming disconnected and falling upon other wires, or upon the ground, or upon persons or animals, or coming in contact with any conductor of the electric current or with combustible material, this device absolutely removes all danger, as it renders a broken wire perfectly harmless; for the reason that the instant the wire separates, the electric current is shut off by this appliance. At the same instant the dynamo ceases to generate electricity until the line is repaired and the automatic safety device is again placed in its proper position to work when needed. The device is manufactured by the Clark Electric company, 192 Broadway, New York.

The Columbia Incandescent Lamp company of St. Louis, which was formed by J. H. Rhodhamel and others last summer, has just been reorganized and incorporated with largely increased capital. Within the next sixty days the company will move into a new building which was specially erected for it, and which, when fully equipped, will enable it to make a larger output than any lamp factory in the west. The pumps and other apparatus are of the last and most approved design. The company has met with great success in the manufacture of a brilliant and long-lived lamp.

The incorporation of the Walker Electric company under the laws of the State of New Jersey with a capital of $200,000, was effected January 14., 1890. This company has already begun the manufacture of the new electric meter. Vice-president and general manager, Geo. W. Walker will be found at the New York office, 50 Broadway, where a complete explanation of the merits of this ingenious though simple meter can be had. The company will also manufacture general electrical supplies. The other officers of the company, Mr. Edwin Scott, president and Lewis G. Tewksbury, secretary and treasurer, are well known business men of New York.

The Aluminum Brass & Bronze company of New York, writes the following in regard to silicon bronze wire: "The resistance of the wire remains about the same either in hot or cold weather and it is not liable to break where it is scratched or cut in handling. For telephonic purposes the supports can be placed two or three times as far apart as the supports for ordinary hard drawn copper wire, and in cities specially long distances can be made on house tops without supports. There is a very common error among telephone people that the superiority of copper wire over iron wire is owing to its higher conductivity, but the real value of copper wire is in the absence of magnetic lag and in the different qualities of induction that take place in copper as compared with iron. We do not hesitate to state that we could furnish silicon bronze wire from which as good results could be obtained as from hard drawn copper wire and the first cost of construction would be very much less for the reason that telephone companies could use a smaller silicon bronze wire than they could copper wire, therefore less weight per mile, and at the same time could place their telephone supports farther apart. As examples of the highest telephonic engineering using silicon bronze wire with marked economy in Europe, can be mentioned the long distance line from Paris to Brussels and the lines throughout Austria."

The adjourned stockholders' meeting of the Standard Underground Cable company was held in the office of the company, in the Westinghouse building, Pittsburgh, last week. The report of the company shows a business of $615,000 for the year 1889, with a net profit of nearly $110,000, or 11 per cent. of the par value of the capital stock, which brings the present surplus of the company to upward of $140,000. The company starts upon the new year with orders on hand at this date aggregating $135,000. The cables and wires of this company have been sold during the year 1889 to 255 customers. These customers are situated in almost every state and territory of the United States, and in Canada, New Mexico, Cuba, South America, Africa, India and Europe. The cables of this company are used for every form of electrical service. Geo. Westinghouse, Jr., was elected president of the company for the ensuing year, and the following gentlemen were elected as directors: Geo. Westinghouse, Jr., Robt. J. Pitcairn, Caleb H. Jackson, Mark W. Watson, John H. Dalzell, J. W. Marsh and Henry Snyder. Owing to the heavy earnings of the company, the stockholders made a fight for a dividend, but owing to the immense amount of business on hand it was decided to hold their surplus funds for a short time. A dividend, however, will be declared by April 1st. The company expects to double its business during the present year on account of the great demand for underground wires.

Electrical Patents.

Issued Jan. 21, 1890.

419,618. Electric Railway System. Thomas E. Adams, Cleveland, Ohio.
The invention relates to electric railway systems and line switches, its object being to provide a series system for such roads with switches for simultaneously breaking the circuit of one conductor, and closing the circuit of the other conductor.

419,633. Galvanic Battery. William Burnley, North East, Pa.

419,642. Insulator for Electric Wires. Isaac P. Cornog, Philadelphia, Pa.

419,645. Telephone Circuit and Apparatus. John N. Culbertson, Buffalo, N. Y.
Claim ten:
"A metallic telephone circuit having a plurality of sub-stations, the telephones at the several stations being connected in multiple arc branches between the two main wires, and the signaling appliance of the several stations being all in series in the said circuit."

419,660. Electric Commutator. Ludwig Gutmann, Fort Wayne, Ind.
Claim three:
"3. A commutator or pole changer whose contact plates are each subdivided, and consist of a good conducting terminal placed centrally and conducting terminals of inferior conducting capacity placed on either side and so arranged that on breaking contact by the brush the current is less than normal."

419,661. Dynamo or Motor. Ludwig Gutmann, Fort Wayne, Ind.
The seventh claim is appended:
"In a dynamo electric machine, the combination of a stationary ring armature, insulating grooved pieces on each side of the core of said armature, and a conductor wound through said grooves and back and forth upon the inner surface of said armature, and retaining bolts passing through said armature and provided with projections which press against the said conductor."

419,662. Electric Commutator. Ludwig Gutmann, Fort Wayne, Ind.
This invention relates to a method for converting continuous currents such as are generated by primary or secondary batteries or by continuous current dynamos into alternating currents similar to those which are generated by the ordinary type of alternating current dynamo.

419,663. Method of Producing Alternating Electric Currents. Ludwig Gutmann, Fort Wayne, Ind.

419,664. Alternating Current Motor Regulator. Ludwig Gutmann, Fort Wayne, Ind.
The first claim reads:
"In an alternating current motor, the combination of an armature having an independent circuit, a subdivided field magnet wire, both the ends of each subdivision being open, and contact slides for coupling all or less of the said subdivisions in multiple arc with one another to the work circuit."

419,673. Electrical Railway System. Thomas H. Hicks, Detroit, Mich

419,674. Shield or Protector for Electric Conductors of Combined Gas and Electric Fixtures. John C. Hollings, Boston, Mass.

419,709. Electric Railway System. Charles Richter, Camden, N. J.

419,710. Electric Protective System. Arthur C. Robbins, Brooklyn, N. Y.

419,727. Method of Treating Secondary Battery Plates. Charles Sorley, New York, N. Y.

419,728. Electrode for Secondary Batteries. Charles Sorley, New York, N. Y.
Claim one reads:
"In a storage battery electrode, an active material consisting of ma-sicot."

419,730. Galvanic Battery. Lucius T. Stanley, Brooklyn, N. Y.

419,731. Portable Faradic Battery. Lucius T. Stanley, Brooklyn, N. Y.

419,733. Cut-Out. Charles B. Story, Brunswick, Me.
This invention has for its object to provide a novel cut-out especially adapted to be employed on incandescent electric light and power circuits.

419,740. Electro-Thermal Current Regulator. Frank C. Wagner, Ann Arbor, Mich.
Claim two follows.
"The combination, with an electro-thermal meter, of an electro-thermal current regulator operating to vary continuously the flow of current to said meter."

419,753. Electric Locomotive. William H. Darling, New York, N. Y.

419,766. Electric Door Opener. Ado Glaeser, Brooklyn, N. Y.

419,771. Overhead Contact and Switch. Robert W. Hawkesworth, East Orange, N. J.

419,774. Galvanic Battery. William E. Irish, Cleveland, Ohio.
Claim two:
"In a voltaic battery cell, a solution of sulphuric acid and mecca oil."

419,776. Electrical Clock. Ansel B. Jones, Cleveland, Ohio.

419,793. Machine for Making Clay Conduits. James J. Powers and Robert Van Buren, Brooklyn, N. Y.

419,808. Electric Motor. Le Roy S. White, Waterbury, Conn.

419,829. Electric Lamp. Sam B. Cobb, Chicago, Ill.
Claim one:
"An incandescent electric lamp comprising the usual bulb, carbon, and conducting wires, and provided on the exterior of the bulb with a non-conducting liquid contained in a single chamber, and surrounding both the wires."

419,841. Electric Railway. Mark W. Dewey, Syracuse, N. Y.
The last claim is appended:
"20. In an electric railway, a line working conductor, a vehicle, an electric motor to propel said vehicle, electrical connections between said motor and working conductor, and suitable means to create counter electromotive force or a tendency thereto in the line conductor between the connections."

419,861. Electric Reciprocating Tool. Harry N. Marvin, Syracuse, N. Y.

419,862. Secondary Battery. Jacob F. Mehren, Chicago, Ill.
The invention relates to improvements in secondary batteries, though certain details may be used to advantage in primary electro-galvanic batteries.
Claim one:
"A perforated plate for electric batteries, having its perforations flaring in one and the same direction toward one surface of the plate, and provided between perforations on the side toward which they taper with ridges or stops."

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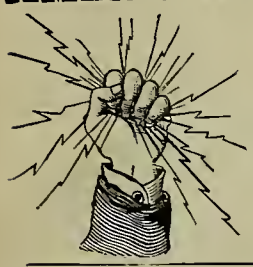

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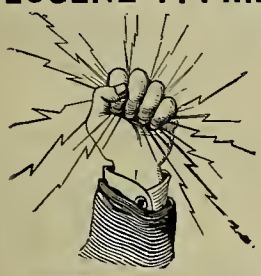

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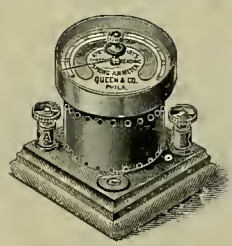

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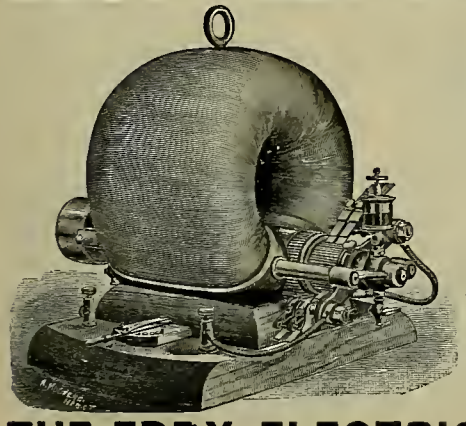

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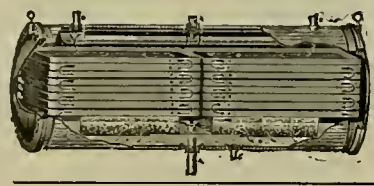

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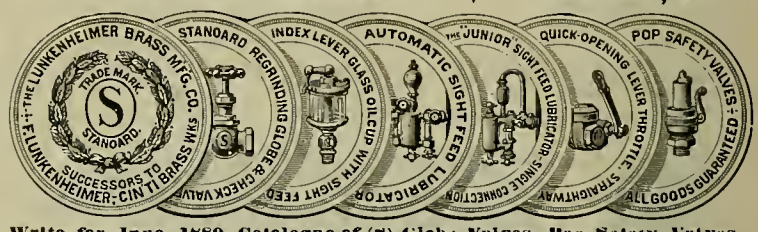

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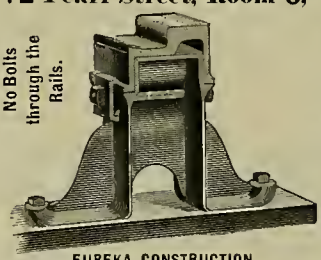

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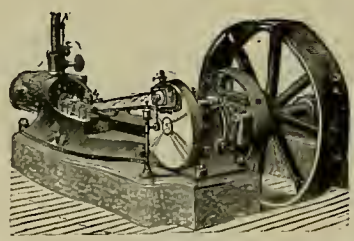

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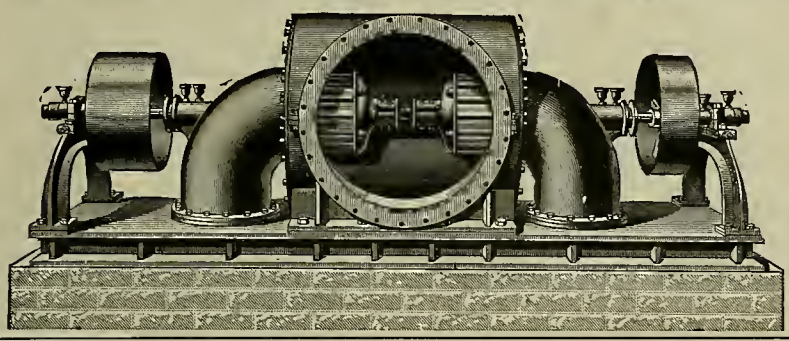

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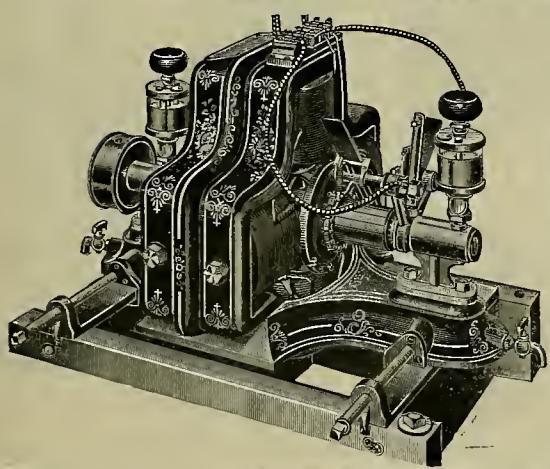

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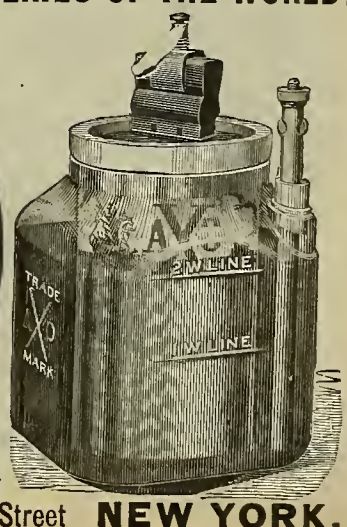

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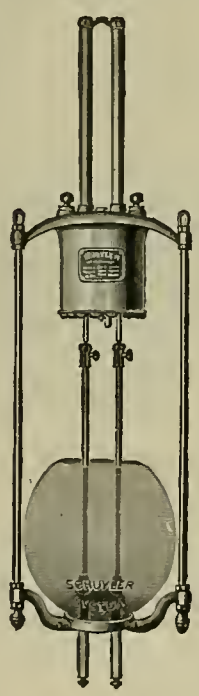

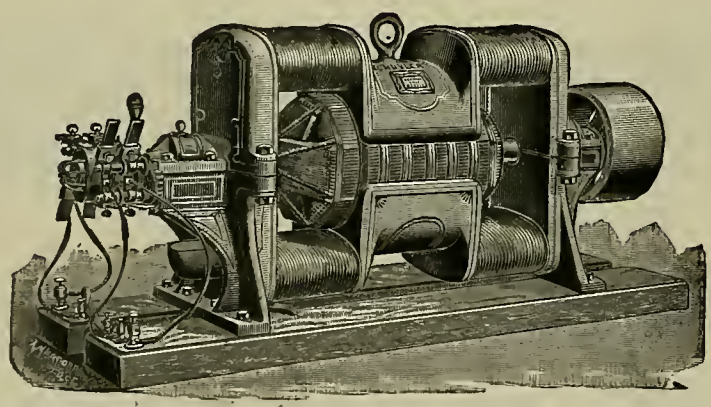

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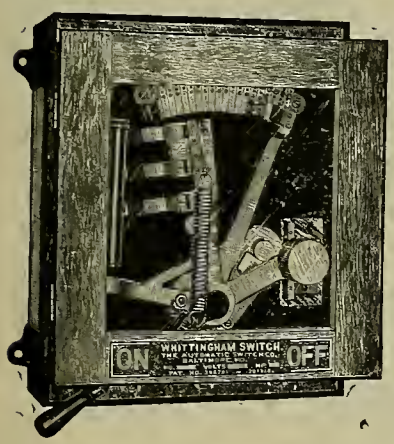

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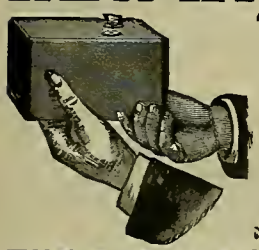

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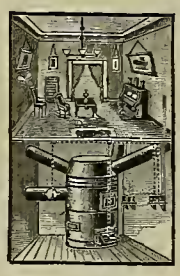

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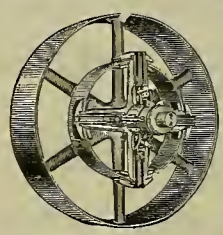

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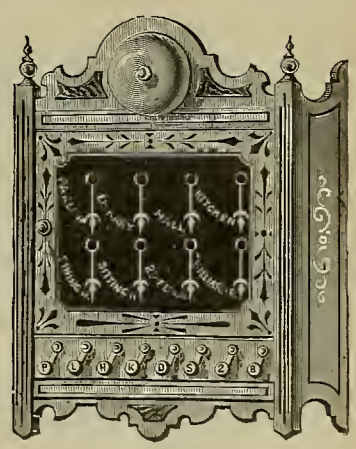

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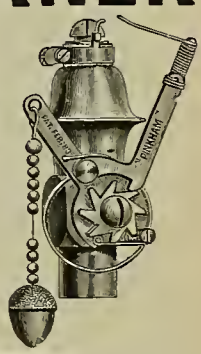

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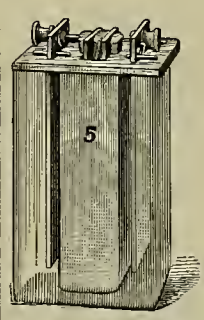

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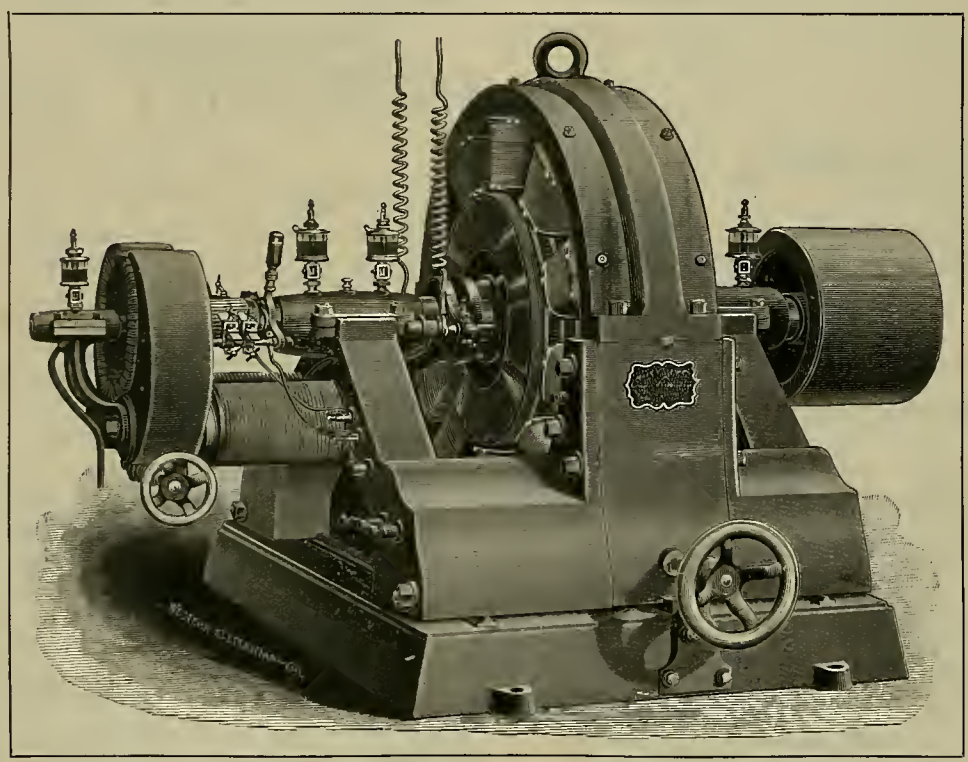

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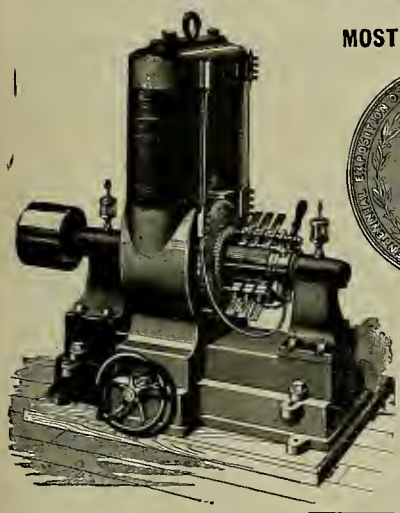

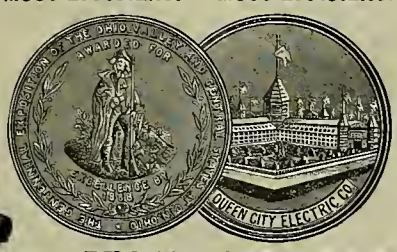

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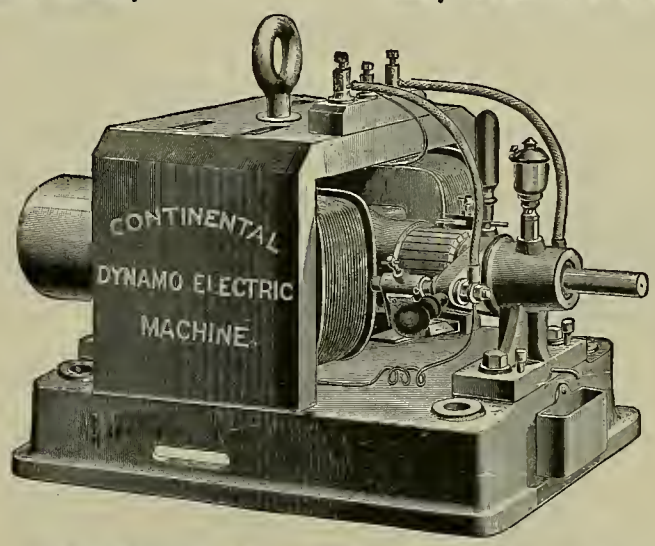

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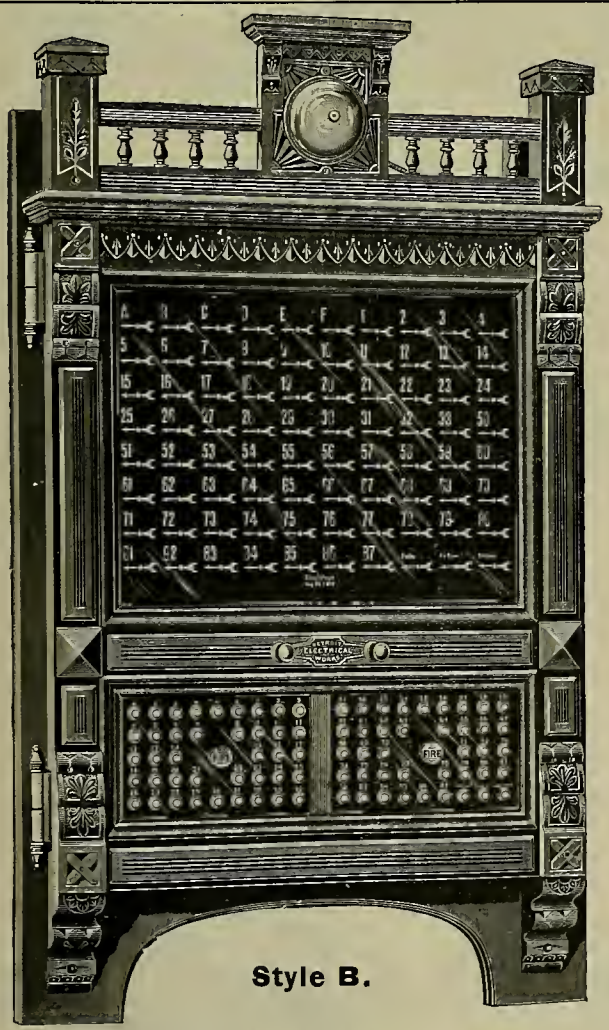

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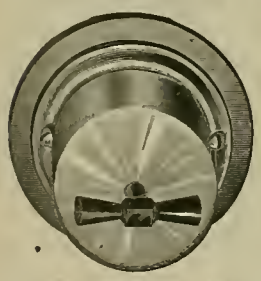

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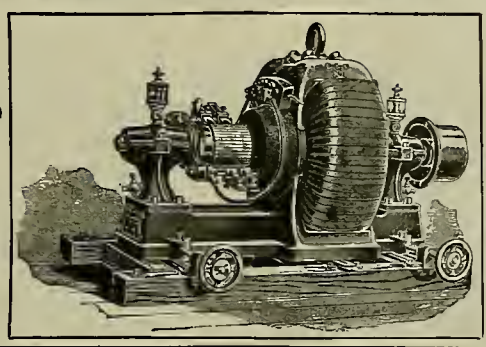

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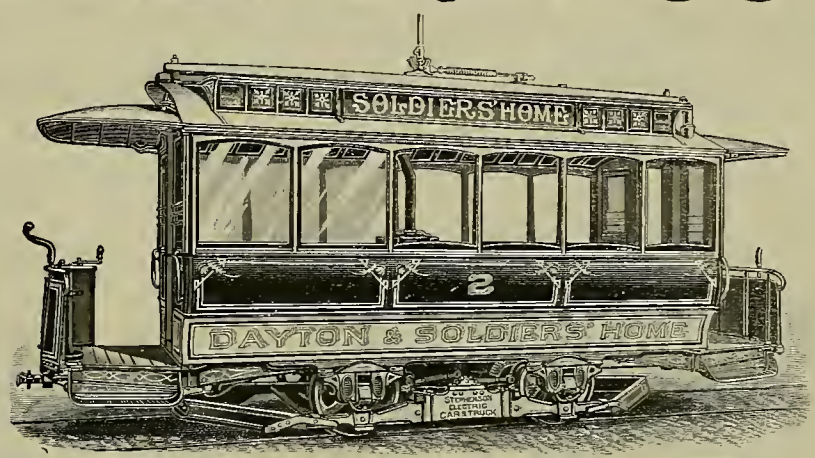

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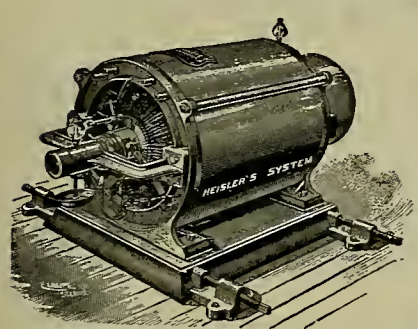

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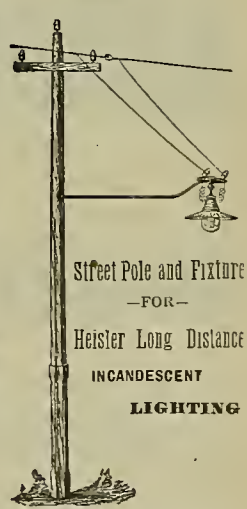

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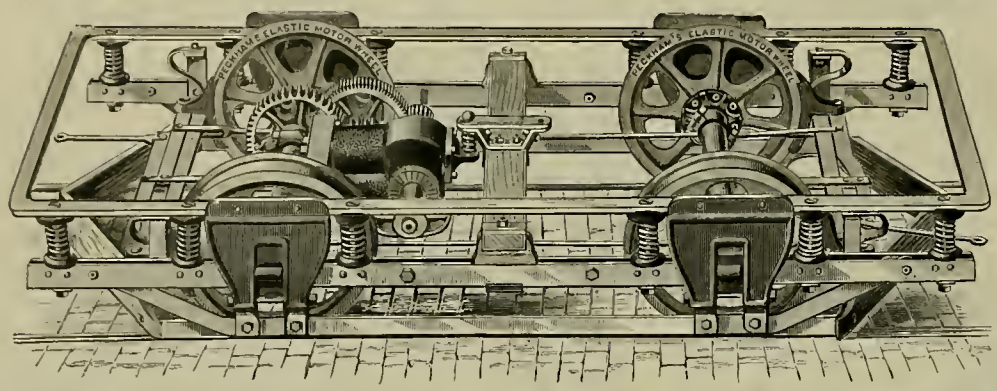

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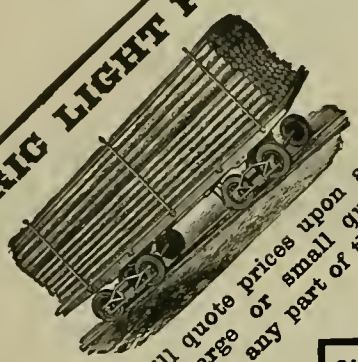

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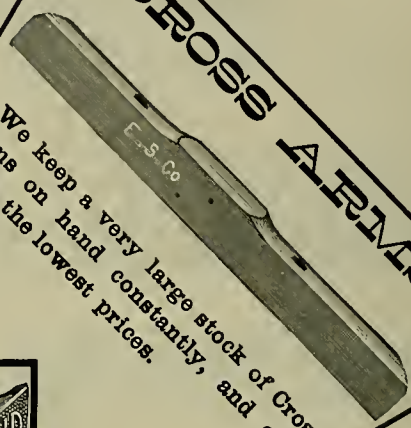

We keep a very large stock of Cross Arms on hand constantly, and can make the lowest prices.

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A Line Wire of Very Superior Insulation.

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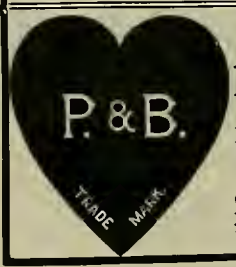

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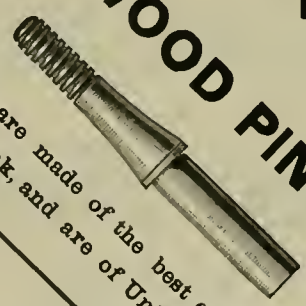

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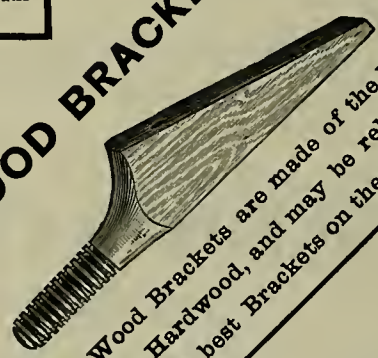

Our Wood Brackets are made of the best selected Hardwood, and may be relied upon as the best Brackets on the market.

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IMPORTANT.

BRUSH PATENT SUSTAINED.

The broad right to the use of Double Carbon Electric Arc Lamps declared to belong to the Brush Electric Company, under U. S. Letters Patent to Charles F. Brush, No. 219,208.

In the suit of The Brush Electric Company vs. The Fort Wayne Electric Light Company, decided at Indianapolis, Dec. 24, 1889,

JUDGE GRESHAM HOLDS:

1. *That Brush was the Pioneer Inventor in Commercial Arc Lighting.*
2. *That the Brush Patent in suit is the Pioneer Patent for Double Carbon Arc Lamps.*
3. *That the Patent is Broad and Fundamental.*
4. *That all its Claims (six in number) are valid.*
5. *That the claims of the Patent are all infringed by the Defendant.*

The Court says: "The separation of the two pair of Carbons, so that the Arc is established between one pair and maintained between the Carbons of that pair until they have been consumed and then automatically established between the Carbons of the other pair and maintained between them until they have been consumed, is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the Lamp in suit from all prior lamps."

The Brush Electric Company is assured by the most competent legal advisers that under this Brush Patent, as interpreted by the U. S. Circuit Court, practically all Double Carbon Electric Arc Lamps now offered for sale are

INFRINGEMENTS

and notice is hereby given that Infringers, whether manufacturers or users, will be prosecuted and held for damages to the full extent of the Law.

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Fort Wayne, Indiana.

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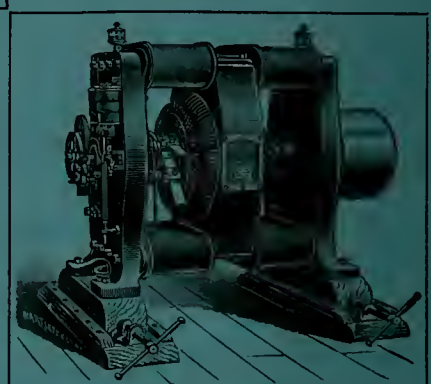

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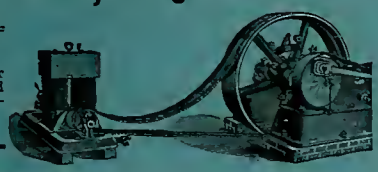

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FOR BARE AND INSULATED WIRE SEE PAGE XXVI.

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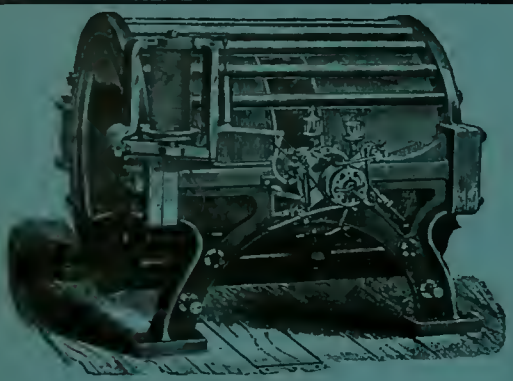

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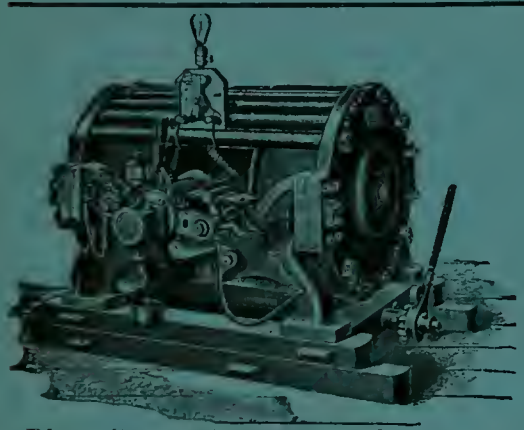
No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent., are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.



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Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.

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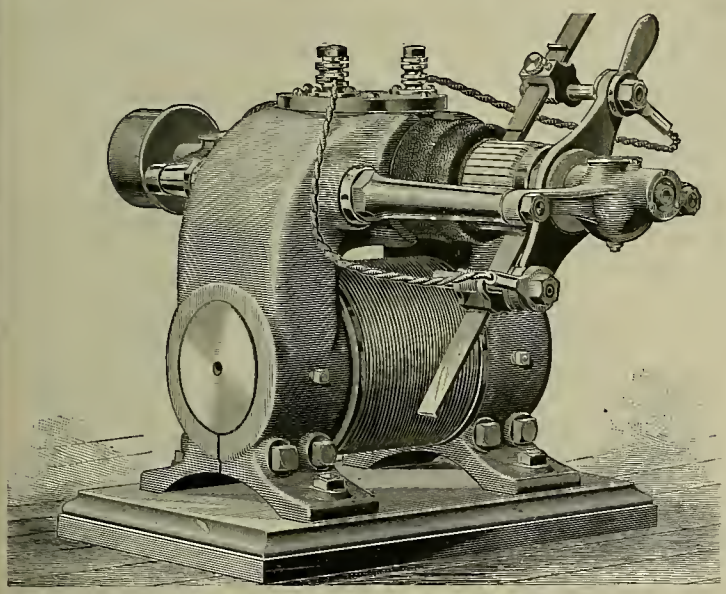

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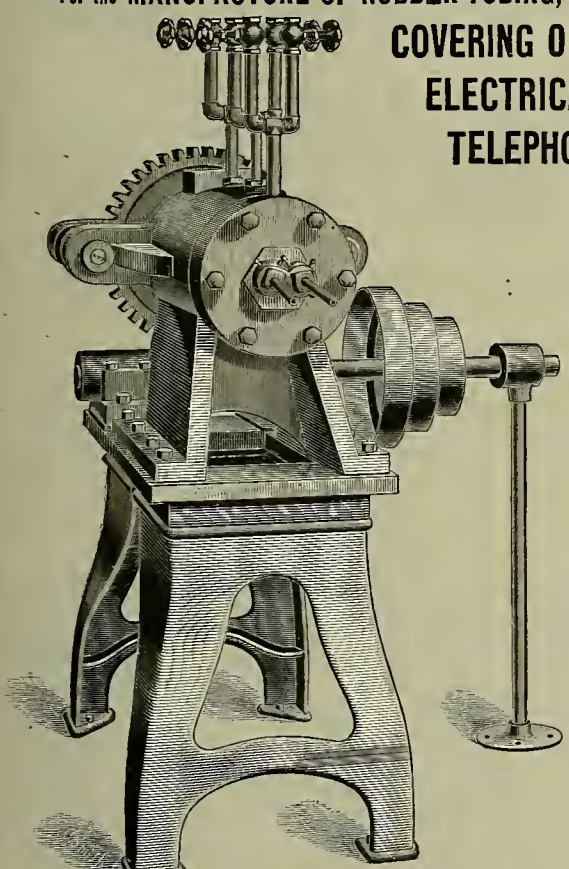

To meet the inquiries and wants of the Electrical Trade, we have perfected a new head to this machine for the covering of electrical wires with the various insulating compounds now in use. Having made several of these for the trade, and finding them giving good satisfaction, we offer it to your consideration.

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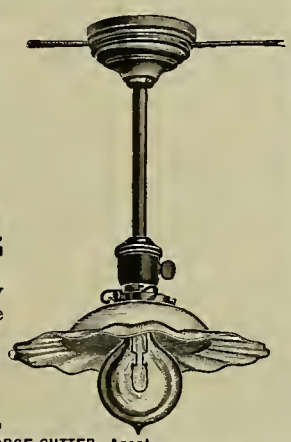

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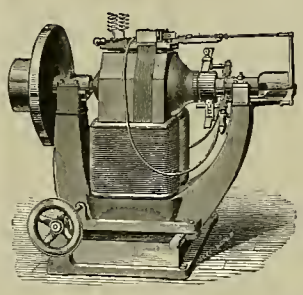

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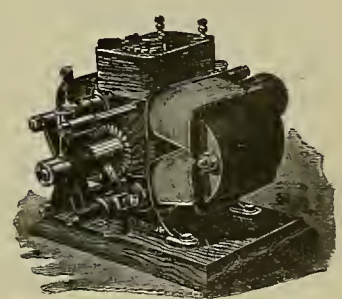

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Ampere Meters.	Accurate, constant, any range desired.
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Dynamos.	Any voltage, from one volt to 1,200. Any current from two amperes to 3,000. Self-oiling bearings, highest efficiency, compound wound or shunt wound. No sparking. Perfect in every detail.
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Miscellaneous Articles.	Such as tape, rubber tubing, insulators, pins, cross-arms, solder, cleats, screws, insulating hooks, insulating compound, always in stock, and sold at best prices.
Supplies.	Of every kind in stock at New York, Chicago, Denver and San Francisco.
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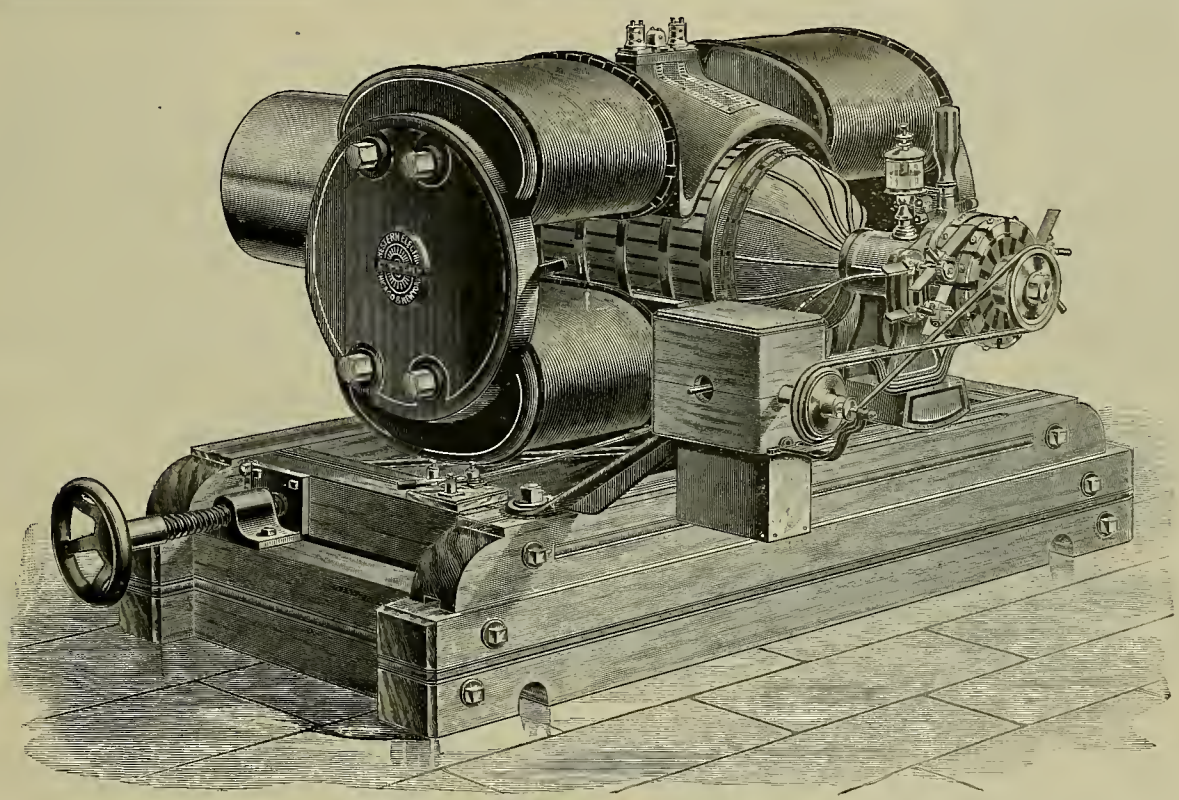
ELECTRIC LIGHTING SYSTEMS.

DYNAMOS

WITH ALL NECESSARY APPURTENANCES.

INCANDESCENT. **ARC, High or Low Tension.**



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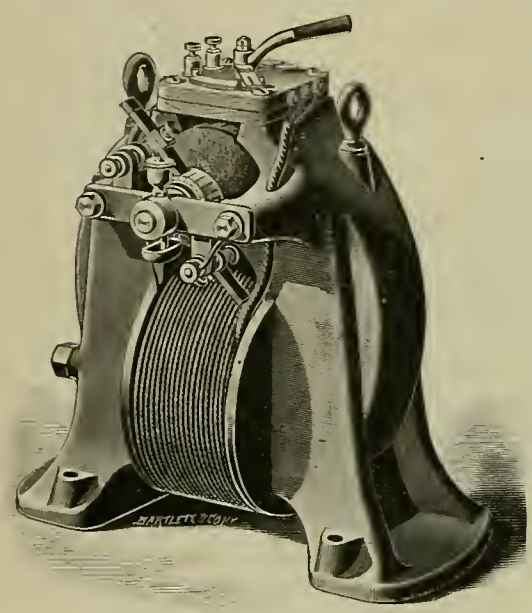
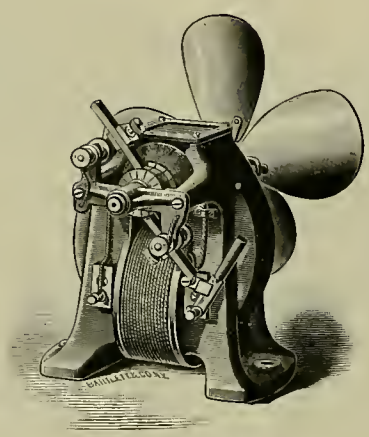
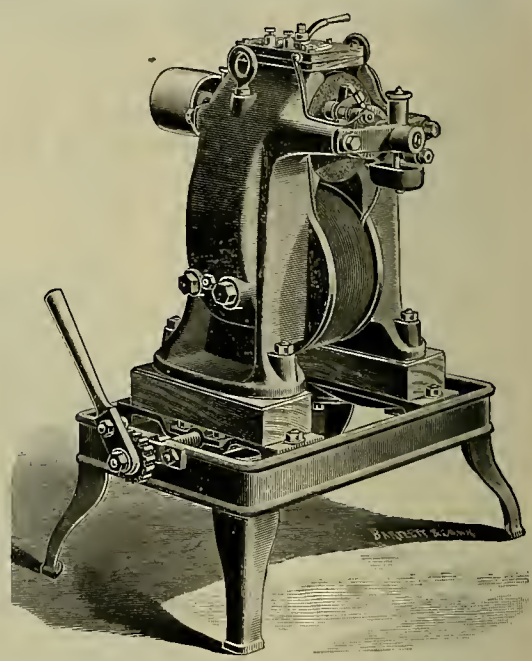


MOTOR WITHOUT BASE.



FAN MOTOR.



MOTOR WITH ADJUSTABLE BASE.

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Manufacturers of Direct Current Generators and Motors for all purposes, from one-eighth horse power Fan Motor up to any size, and of any Electromotive force required.

Generators and Special Motors for Traveling Cranes, Elevators and Mining Purposes.

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UNSCRUPULOUS PERSONS MANUFACTURE LAMPS
IN BASES STAMPED

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ARC LIGHTING EXTRAORDINARY.

Manufactured under Patents of Stanley, Wallace and Others.

Single Carbons requiring renewals only once in four days.

The mains may be carried underground and have no electrical connection with the circuits and the lamps, embodying the same features of separation between the current in the street mains and that in the lamp, as is found in the incandescent system of The **WESTINGHOUSE ELECTRIC COMPANY** through its converter.

The single carbon admits of a larger and more powerful arc than can be obtained from the ordinary two carbon lamp.

The system fully covered by patents.

The dynamo may run all day on a short circuit. A short circuit on the line will not burn out an armature.

The machine is self-regulating from one lamp to its full load, without any extraneous device.

The saving in cost of carbon renewals in this system in the course of a short time would justify the entire replacement of any existing arc system by this new one.

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What are the Essential Features in any Comprehensive Electric Railway System?

Main Feeders from Power Station.
Main Conductor Feeding in Trolley Wire.
Uniform Size of Trolley Wire, Independent of Length of Line, or Number of Cars Operated.

AND WHY?

BECAUSE, Thereby only can be secured **Uniform Electrical Pressure.**
Absolute Reliability of Service.
Non-interference with one section by interruptions upon any other.

The Sprague Company will guarantee to operate a ten mile Thirty Car, Double Track System with

Less Engine Power;
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Less Weight of Conductors;
Less Loss in Distribution;
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OR IN WORDS THAT ARE UNDERSTOOD BY ALL, WITH

More Car Miles per Ton of Coal Consumed;
More Miles of Line with a Given Loss;
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THAN CAN BE DONE WITH ANY OTHER SYSTEM.

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Flexible Yielding Support for Relief of Strains;
Universal Movement of the Trolley Pole;
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A New and Improved Method of Equipping Buildings with an Insulated Tube Conduit for any System of Electric Wiring.

COMBINING:

SAFETY—Absolute immunity from electric fires.
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DURABILITY—Absolutely moisture-proof tube and appliances, insuring longevity of wires.
CONVENIENCE—Systems of electric wiring may be laid out on original plans in a manner similar to that employed for gas, water and steam piping; the conductors may be drawn in at pleasure.

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Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

SPECIAL.

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SWITCHES

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Exhibited at Kansas City Electrical Convention by Mr. Wm. R. Hood.

Exhibit Found in his OVERCOAT POCKET.

LOOK HIM UP.

USE THE BEST INSULATION.

The CELEBRATED P. & B. ELECTRICAL COMPOUNDS.

Thoroughly MOISTURE and WEATHER Proof, resist the STRONGEST ALKALIES, STRONG ACIDS, FUMES and GASES; also P. & B. WATERPROOF WRAPPING and INSULATING PAPERS.

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Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, FEBRUARY 8, 1890. No. 6

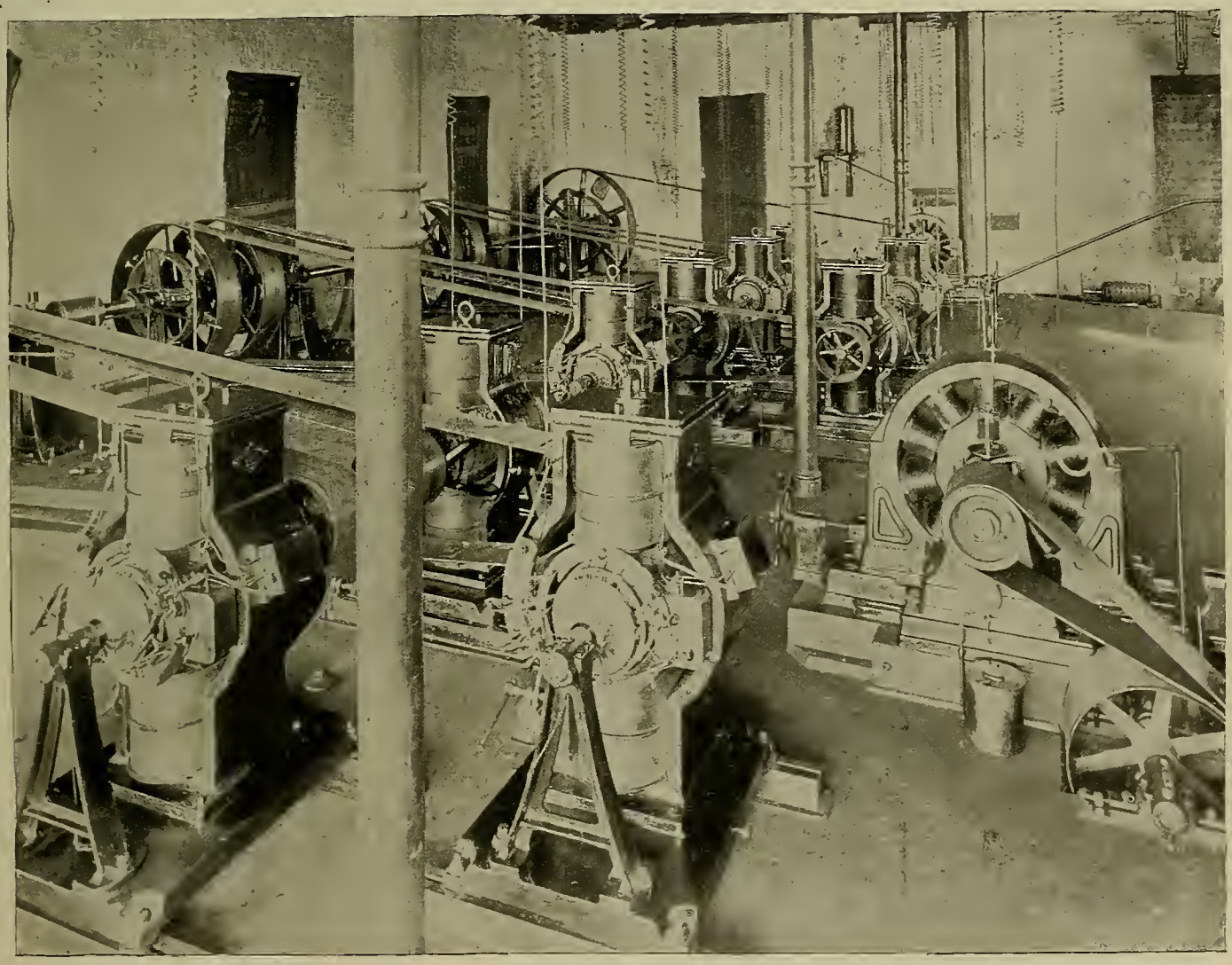
Consolidated Electric Light Company's Plant at Kansas City.

The accompanying cut shows the dynamo room of the Consolidated Electric Light & Power company's plant at Kansas City, Kan. The station is equipped with Excelsior machines. Arc lights are furnished for streets, public parks and commercial purposes, and an alternating system is also in operation. It is proposed to introduce a motor service at an early day. The success which has attended the company thus far encourages its officers in the belief that within a year the capacity of the plant may be doubled.

The company operating the plant was formed about two years ago. In June, 1888, it secured an exclusive franchise for twenty years, and at the same time the contract for the city lights. At the present time the capitalization is $100,000 and the officers are: President, I. D. Wilson; vice-president, Mark Harris; secretary, Ben Schnierle; treasurer, B. Friedburg; general manager, B. Friedburg; attorney, F. C. Hutchings; superintendent, G. W. McCan.

In February, 1889, operations were begun, and the plant has proved so successful that the capacity has already been increased twice. At present eleven 30 light arc Excelsior machines are in operation and two Westinghouse alternating dynamos of 750 lights' capacity each, have been added. These are operated by two engines—a 300 horse power Corliss and a 75 horse power Armington & Sims. Babcock & Wilcox boilers are used.

The city plant consists of 250 lamps. These are distributed through the principal streets and the parks, one of the latter being six miles away from the station. The tower and mast arm systems of distribution are used, and the result is highly satisfactory. The company claims to be operating over 100 miles of circuit. The conductors are all overhead, and the construction is of the best character. The service is excellent and the people are so well pleased with it, especially the street service, that it is expected the gasoline lamps will all be replaced by arc lights at an early day. The system also meets with favor among the merchants of the city.



CONSOLIDATED ELECTRIC LIGHT COMPANY'S PLANT AT KANSAS CITY.

The Ohio legislature has adopted a joint resolution providing for the appointment of a committee to inquire into the desirability of lighting the statehouse by electricity.

Kansas City Convention of the National Electric Light Association.

There is every indication that the convention of the National Electric Light association in Kansas City, February 11, 12, 13 and 14, will be successful in every respect. Reports from the East are to the effect that the "Electric Limited" train will have a large number of passengers on board when it leaves Jersey City on February 9th. Certainly the attendance of Western delegates will be large if the interest now generally manifested in the meeting signifies anything. The Eastern delegates will reach Chicago shortly after 9 A. M., February 10th. They will be the guests of the Chicago Electric club. Lunch will be served at the club rooms from 11 A. M. until the last guest departs for the train, which will leave on the C. B. & Q. road at 5 o'clock. Music will be furnished by an orchestra.

The Commercial club of Kansas City, last week decided to tender a reception in honor of the visiting delegates. It will take place on the evening of February 11th. After the club had decided to give the reception, E. R. Weeks, president of the National Electric Light association, made a brief speech, in which he thanked

the organization for its hospitality. He said: "When you remember how much the commerce of the world owes to electricity the resolution just passed by the Commercial club of Kansas City seems most appropriate. In view of the fact that the press is now teeming with what are often sensational reports of our shortcomings, and in view of the fact that the public seems disposed, like Brutus, to set all our faults in a book to be learned and 'conned over by rote,' and seems inclined to either forget or ignore our past services and present usefulness, your action is most timely and will be fully appreciated by the electrical fraternity of the whole country. In the National Electric Light association both the scientific and commercial elements are represented. The association may be said to be like the shield in the fable—both gold and silver. We have the gold of pure science and the silver of practical application. There are men who without a commercial consideration devote their lives to study and experimental researches. There are also men of affairs who have put hundreds of millions of dollars into applied electricity and who lose sight of no commercial consideration. Kansas City is now throughout the civilized world a synonym for enterprise and progress, and Kansas City bids fair soon to become as generally recognized as a synonym for hospitality. By your action you have honored the National Electric Light association, and have done that which will redound to the honor and profit of the commercial interests of Kansas City. On behalf of the National Electric Light association I thank you."

A. V. Garratt, secretary of the National Electric Light association, has issued the following circular:

CREDENTIALS AT THE KANSAS CITY CONVENTION.

From the fact that the undersigned is receiving many letters from gentlemen connected with electric lighting central station companies in all parts of the United States, requesting information as to what credentials will be required to obtain the full privileges of active membership, at the Kansas City convention Feb. 11–14, I desire to say that there is no constitutional provision nor written by-law covering this question.

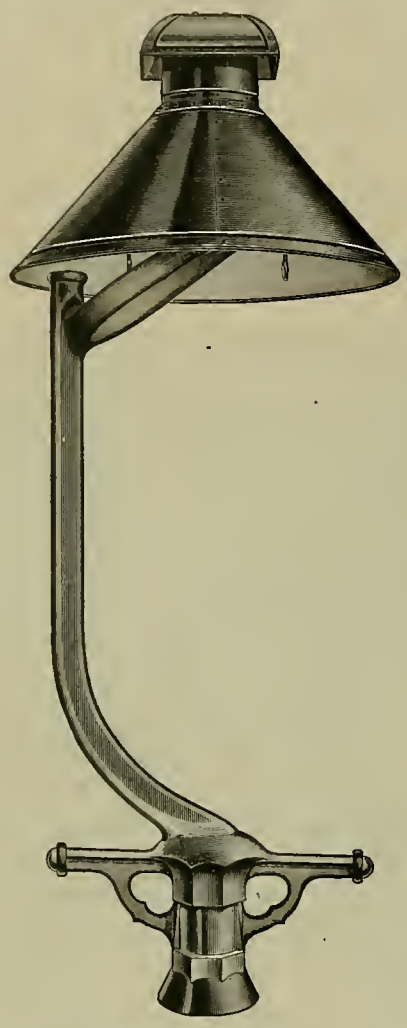
DEVICE FOR ADJUSTING THE POSITION OF INCANDESCENT LAMPS.

Any deliberative assembly, composed of individuals representing corporations, undoubtedly has a right to require any delegate to prove that he is authorized to represent the corporation under whose name he votes. For this reason and because of the fact that the coming convention will be attended by a large number of new members it is very desirable that every gentleman who takes an active part in the convention bring with him a letter from the central station company, under whose name he votes, naming him as its representative.

For the reason that the papers and committee reports to be read at Kansas City are not only greater in number than at any previous convention but are of more than ordinary value, treating as most of them do with the practical questions which demand an immediate solution at the hands of the electric lighting fraternity; and also on account of the very elaborate and complete exhibit of apparatus by the associate members, it is desirable that everything be done which will facilitate getting the convention quickly into working shape. Nothing will facilitate the work of the convention more than for each delegate to come properly accredited. ALLAN V. GARRATT.

Hood for Arc Lamps.

The accompanying cut illustrates the new style of hood for arc lamps adopted by the city of Chicago for its street system. This novel



HOOD FOR ARC LAMPS.

design is manufactured by the Western Electric company of Chicago, and possesses many points of merit that will commend it for this class of work. It is made of heavy galvanized iron, japanned, supported by a single arm in a cast iron base. It will be noticed that the curve and shape of this arm, gives the lamp the appearance of being hung therefrom. The principal advantage from this style is the absence of shadows. This arm may be placed between the lamp and the corner of the building, when the lamps are placed at short intersections, and the light from the lamp is then distributed without shadows from the framework.

Device for Adjusting the Position of Incandescent Lamps.

The accompanying cut illustrates an ingenious device for adjusting the position of an incandescent lamp. The appliance was invented by Dr. W. F. Bradner of Greeley, Colo., who, when working at his dentist's chair, realized the desirability of some device which would enable him easily to raise or lower an incandescent lamp. The device consists of a suspending cable or cord, having interspersed in its length a differential pulley composed of two drums of different diameters, from one of which the cable extends up to the ceiling or other point of support, and from the other of which the cable descends to the lamp or other object. The differential pulley forms a weight which, when the lamp is lifted, gravitates. When the cord from the smaller pulley is unrolled, the slack of the cord on the larger pulley, is rolled up, the balancing effect of the two pulley-surfaces serving to hold the lamp to any adjustment without special appliances. There is no spring used in the device. The differential pulley is inclosed in a bulb, which for a 16 candle power lamp with shade, is about three inches in diameter. The device will be put on the market by B. D. Sanborn of Greeley, Colo., who will exhibit it at the Kansas City Electric Light convention.

Western Electric Railway Association.

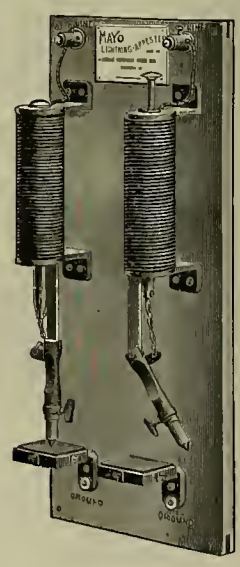
The Western Electric Railway association held a brief session in Chicago, January 29th. No business was transacted. It was decided to adjourn until June 11th next.

Chicago Electric Club.

At the meeting of the Chicago Electric club last Monday evening President Beach called upon F. E. Degenhardt for a report of the entertainment committee. Mr. Degenhardt said that the committee had completed arrangements for the entertainment of the eastern delegates to the Kansas City convention during their visit in Chicago next Monday. He gave a detailed account of the preparations referred to elsewhere, and the club accepted the report, and at the same time referred the matter of invitations to the committee. Elmer A. Sperry read an interesting paper, presented elsewhere, on the "Operation of Electric Motors with High Tension Currents." A vote of thanks to Mr. Sperry was unanimously passed. The discussion of the paper was one of the most interesting of the season.

Mayo Lightning Arrester.

The Mayo lightning arrester is illustrated in the accompanying cut. This device is extremely simple in construction, is automatic in operation, and requires no attention whatever, as there is no winding up or setting. By reference to the cut it will be seen that there are two carbon pencils suspended from rods passing through coils. These pencils hang above ground



MAYO LIGHTNING ARRESTER.

plates, as shown, when they are in position. In the cut it will be seen the point of one of these carbons is raised to one side. This is done when the coil is energized. The discharge is of course instantaneous, and the pencil drops back to the original position. If a number of discharges follow each other in rapid succession, the desirability of this device will readily appear as the instrument is instantaneous in its operation and adjustment. The device is manufactured by the Rockford, Ill., Electric Manufacturing company.

The LeGrande Edison Electric company of LeGrande, Ore., received 100 horse power steam plant from the Ball Engine company of Erie, Pa. This plant was put in by the Northwestern Electrical Supply and Construction company, of Seattle, Wash.

Electric Tramway at a Mill.

A need of better facilities for the transportation of supplies and manufactures has led to the adoption of electricity as a motive power in many large mills and factories.

This has usually been easy to accomplish owing to the fact that nearly all the important

ELECTRIC TRAMWAY AT A MILL

mills are provided with lighting plants, so that from the same dynamo which supplies the lamps sufficient current can be taken for the operation of an electric tramway.

The accompanying cut gives a view of the tramway recently installed by the Thomson-Houston Motor company at Salmon Falls, N. H. The total length of the track is about 2,000 feet, extending the entire length of the mill yard; it is of standard gauge, 4 feet 8½ inches, and laid with T rails.

The same method of overhead construction as is employed on street railways is used here, the trolley wire being suspended from cross wires and brackets. In order to make the return circuit more perfect than would be the case if the rails only were used as conductors, a supplementary wire is run between them and connected by tie wires, one end being riveted to the rail and the other soldered to the supplementary wire.

The generator used for supplying the current is a shunt-series machine, wound for 500 volts, and capable of delivering 15 horse power. It is placed in the basement of the mill, and is driven by water power. The motor car is 14 feet long and 6 feet wide. The truck which has a wheel base of 4 feet 6 inches, is equipped with two 3 horse power railway motors capable of taking a load of 6,300 pounds up a grade of 5 per cent. without the least difficulty.

The advantages to be obtained and the saving in handling supplies and finished goods effected by the use of electric tramways, cannot fail in a short time to bring them into general use. They are just as applicable to interior work where a truck can be used to collect material, transport it to the elevators and to the various parts of the mill. The Thomson-Houston Motor company has already made several installations of this sort, and has many new ones under contract.

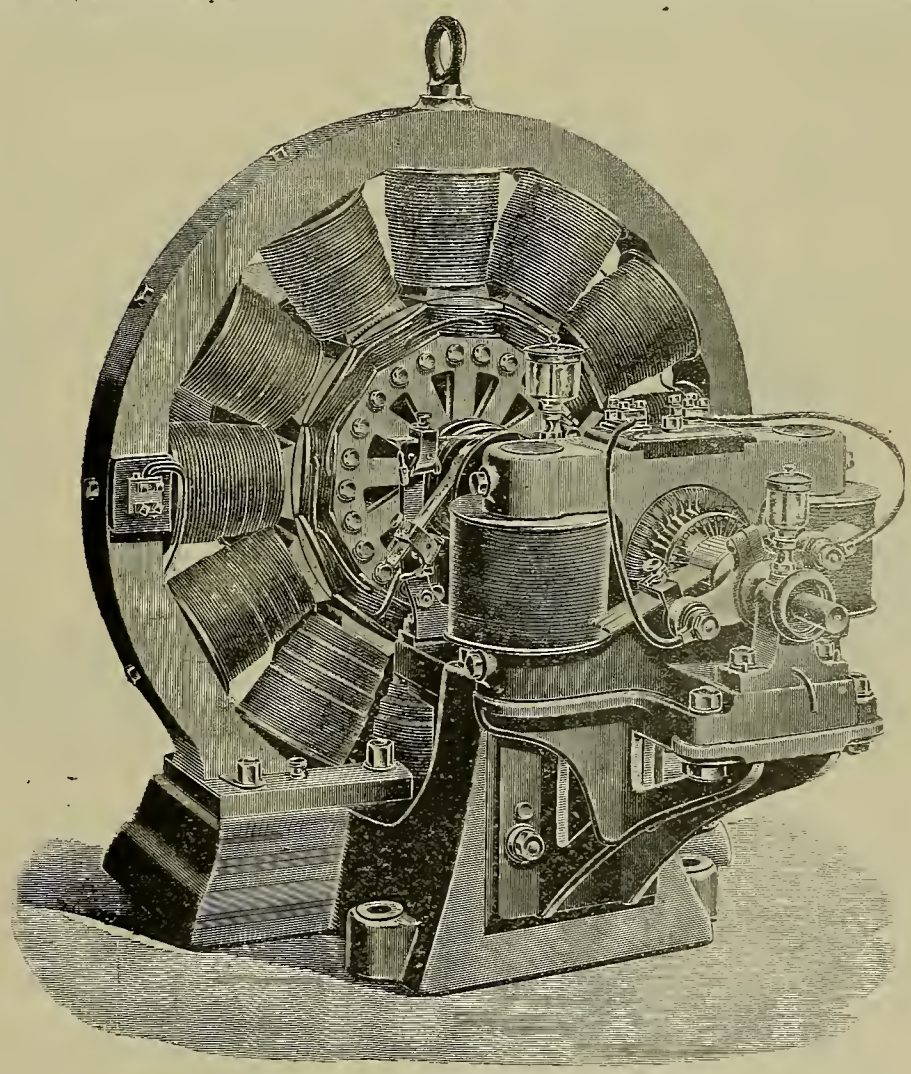
New York Board of Electrical Control.

The first meeting of the Board of Electrical Control of New York since the retirement of Commissioner Gibbens, was held last week and was signalized by the change of attitude of the subway board. It will be remembered that the representative of that company some time ago announced that it would be impossible to build at once subways enough for the wires that were condemned by the city inspectors. Thereupon the mayor asked that other companies be given an opportunity to compete with the Subway company. To this the latter company objected, and was supported in its opposition by the commissioners, Mayor Grant alone voting to let the other companies in. Now the Subway company volunteers to build any number of miles of conduit and to have the work done in time to let the commissioner of public works pave the streets before next winter. This proposition rather surprised Mayor Grant, and he instituted an inquiry that revealed the fact that the Subway company was contemplating sub-letting its contracts for construction. The mayor decided to consult the law department of the city government before giving his approval to the scheme. Henry S. Kearney, the engineer of the board, submitted a plan for work which was considered, and then permission was granted to telegraph and telephone companies to use subways which will be built in these thoroughfares: Greene street, from Spring to Canal; Eighteenth street between Seventh and Eighth avenues; Eighth avenue, from Eighteenth to Thirty-eighth street; Twenty-third street, from Second to Madison avenues; Fifty-eighth street, from Tenth avenue to Hudson River; Seventy-ninth street, from First avenue to Avenue A; 124th street, from Lexington to St. Nicholas avenue; Twenty-first street, from Lexington to Fourth avenue; Lexington avenue, from 129th street to Harlem River; Third avenue, from 129th street to Harlem River.

Before the meeting adjourned, the mayor had a slight dispute with Engineer Kearney, and then took occasion to deliver himself rather emphatically to the representatives of the Subway company. telling them what they would be expected to do.

Mather-Platt Alternating Current Dynamo.

The cut presented herewith illustrates a new alternator which is now being manufactured by Mather & Platt, Manchester, England. As is the case with most alternate-current machines in which the armature contains iron cores, the armature revolves, and the magnets are fixed. The magnets are wrought iron and are arranged round the armature, exterior to it, and are attached to a massive cast-iron ring which forms the yoke connecting the limbs. The attachment is so arranged that any of the magnet cores can be removed without disturbing the remainder, or taking out the armature. The armature is constructed of two plates or disks keyed on to the shaft, between which the armature cores are held by bolts. As with the magnets, any section of the armature can be removed without disturbing the remainder. Apertures in the disks allow free ventilation in the interior of the armature cores. The magnets are excited by a Manchester dynamo, which is carried on a bracket bolted to the bedplate of the alternator, the armature shafts being coupled direct.



MATHER-PLATT ALTERNATING CURRENT DYNAMO.

The machines are manufactured under the

patents of Drs. John and Edward Hopkinson. For working with transformers they are constructed either for 1,000 or 2,000 volts, and from 8,000 to 12,000 alternations per minute, or with a "periodicity" of from 66 to 100. The machines, it is claimed, can be run in parallel and may be thrown into parallel working without the least danger, even when there is considerable difference between the electromotive forces at the terminals, or the machines are running at different speeds.

The dynamo illustrated is for an output of 1,000 volts and 30 amperes at 800 revolutions per minute. The armature resistance is .55 ohm, and the resistance of the magnets 2 ohms. An efficiency of 95 per cent. is claimed for this machine. The cut is reproduced from *Industries*.

Operation of Electric Motors with High Tension Currents.[1]

By Elmer A. Sperry.

The recent advance in the transmission of power by electricity in this country and abroad and its adoption on a more or less extensive scale for the utilization of distant water powers in the mining districts, indicate that the state of the art has reached that point where it has ceased to be an experiment, and where the most direct methods and the betterment of the various details of construction are matters of paramount importance. The present widespread interest in high tension currents and the discussion in connection with their use in the distribution of electricity for electric lighting, lead me to the few remarks which follow, hoping to direct attention to their employment in the transmission of power,

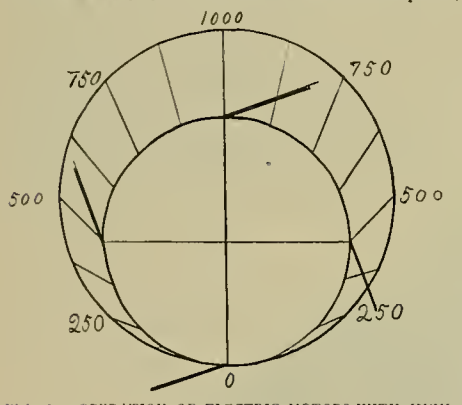


FIG. 1.—OPERATION OF ELECTRIC MOTORS WITH HIGH TENSION CURRENTS.

that this field for the use of high tension currents may not be neglected and may also receive whatever benefit may result from the general discussion now in progress.

For the transmission of power from one point to another there can be no question as to the utility and great advantage of employing high potentials. I speak now of the transfer of power from one point to another as contra-distinguished from the distribution of power for domestic or like purposes on a wide-spread scale. I, however, see no reason why in the near future, this latter system also should not be prosecuted along the lines of high tension currents, inasmuch as the phenomenal progress which has characterized electrical engineering enterprises in the past will bring the question of insulation to a point where danger to life and property will almost entirely cease to be an element to be considered. This will doubtless be brought about, too, by the utilization of safety devices in the central plant, as well as throughout the construction.

In the consideration of high potentials as applied to the transmission of power, I propose to take a practical instance and carry it out along the line of each of the two foremost plans known to electrical engineers, namely, first by constant current, and second by constant potential, hoping by this means to point out the principal differences and ascertain, if possible, which is the better, cheaper and more desirable method.

Before starting with the examples it is desirable to settle the fact that the work of each of the plants shall be satisfactory in so far as practical operation is concerned.

This will depend upon economy and regulation. We will assume, so far as the practical operation is concerned, that with shunt, compounded or over-compounded generators, and with shunt or compound wound motors, the matter of regulation may be satisfactorily worked out. But can the regulation be equally well maintained upon the constant current plan?

It will be granted by all who have investigated the matter that constant current generators can be regulated automatically, as to their potential, from zero to full load, in response to demands thereon for work, and this is done in a satisfactory manner.

But referring to the motor, the argument urged against the constant current method is that the field coils, each have to be divided into a great many parts, each of these parts led to sections of a stationary commutator, and contacts driven backward and forward over this commutator by means of the centrifugal force of the varying speed-tendencies of the motor. That the potential difference of a constant current motor may be made to meet the varying demands thereon for work, has been demonstrated. But it has been further demonstrated, that the method of simply rotating the brushes about the commotator, between the points of zero and maximum potential difference, in a constant current motor, may be satisfactorily employed to regulate the electrical energy absorbed

The problem here is to obtain a sparkless commutator. This has received its solution and the mathematics of the various functions is known, and holds equally in motors or generators of any size. Furthermore, the sparkless region for varying currents has been broadened out until it is made to comprehend a variation of 50 per cent. of the normal current either side of the normal current point By this is meant: Suppose the normal current to be 40 amperes, then there is a region of 20 amperes lying half each side of the 40 ampere mark through which range the commutator is entirely sparkless. This seems to me to be by far the simplest way by which to adjust a constant current motor. Various devices may be employed to accomplish the mechanical rotation of the brushes in response to varying speed-tendencies, but that which will recommend itself as being the best is the one in which the varying centrifugal forces are called upon to do the least amount of mechanical work. These forces are not great until the speed differences are great, hence for close regulation they should be called upon to perform only functions involving light duty; for instance, calling into action mechanical forces which in and of themselves perform the ultimate duty of rocking the brushes, especially in heavy machinery where these elements are more or less large and ponderous.

The question may be asked: Can centrifugal force ever be employed to hold the motor within the same speed limits as shunt or compound winding? I answer, it can. There is no reason why the same degree of perfection should not be attained in this as in steam engineering. There are steam engine builders who will contract to hold the speed within 1½ per cent from full load to zero. No better result than this need be desired in any motor.

Electrical science has advanced so rapidly and the theories have changed so radically that statements put forward but comparatively a few years ago naming impossibilities in the art have been often exhumed in the present day as marks of advancement. Writers on dynamo machinery are so modern that, profiting by the errors made by former writers upon other subjects, they have been rather wary in pointing out impossibilities. But sweeping assertions must be made, and writers who are considered as high authorities have pointed out the impossibility of making a sparkless commutator under the conditions named above. Since it now has become an accomplished fact, it may be said that doubtless these statements denying the possibility of results of great importance are useful as incentives to those working along the line, who do not agree with the author.

There is, however, one point with regard to a sparkless commutator, under conditions of constant current which I wish to point out, namely: That from the maximum to the minimum point of potential the brush must always be handled in the direction it points from the former point toward the latter, and not in the opposite direction. The distribution of potentials about a commutator is shown in Fig. 1. From this figure it will be seen that the distribution is equal on either side of the maximum line and there seems on the face no reason why the brushes should not reduce the potential if rotated in either direction from the maximum point. Either toward the left or toward the right the minimum point or position B or B'. While the brushes in their movement to the left are perfectly non-sparking, if attempt is made to move them in the opposite direction to position B' they spark seriously. No reason for this has been put forth to my knowledge. The following is offered as a possible explanation of this phenomenon. Allow Fig. 2 to represent either a dynamo or motor with commutator at center and armature cord disposed between N N, the north pole pieces, and S S the south pole pieces; t t t and f f f show the windings; n indicates the polar axis of the armature. When this armature is used as a generator it will rotate in the direction of arrow G and when used as a motor it will rotate in the direction of arrow M. The small arrows under the pole pieces, indicate the direction of the lines of force to or from the armature core. Suppose the system to be operated as a generator and the brushes to be rotated over toward the right. The polar line n or the pole in the armature will be held by the overmastering magnetism of the pole pieces to a position which constantly tends to be back of or toward the left of the brush contact, thus leaving the brushes among the coils f f f. The current in these coils is in the direction going from the observer and hence is antagonistic, if the expression be permissible, to the direction of the lines of force emanating from the poles N N, therefore there is no tendency to the development of abnormal electromotive forces between the adjacent coils. However, if the brushes be rotated to the left the displacement or the drawing of the polar line n by the south pole and its being repelled by the N N will still keep it to the left of the commutator brush contact. As soon as the windings f f f, come within the range of the pole pieces S their current direction is in harmony with the direction of the lines of force into the pole pieces S S, thus giving an exaggerated value to the potential developed in adjacent coils. These coils being directly under the contact of the brush develop local currents acting through the brushes producing the tremendous sparking observed.

When the system is used as a motor and is revolved in the direction of the brushes and arrow M the converse of this law operates, inasmuch as the polar displacement is reversed which would require, as is found in practice, that the brushes M should be rotated to the left for non-sparking instead of to the right as in the case of the generator.

To proceed with the example. Let us take a transmission of 50-horse power three miles distant upon a circuit of 31,680 feet. Place the total economy of transmission at the low figure of 66 per cent. which will be distributed 14 per cent. each in dynamo and motor, and 5 per cent. in the line. We will adopt as potential 3,000 volts; transmissions are used twenty-four hours a day with this voltage as well as scores of arc light dynamos with no practical inconvenience. This voltage would give about 18.7 amperes in the constant current distribution. Let us assume that a constant potential may be worked upon the same voltage. Now let us examine the two plants. The line wires are the same size; with this difference, however, that in the constant current they are only subjected to 3,000 volts at such times as the plant is working at its maximum; during all other times the voltage is below, thus subjecting the insulation to a far less strain with less liability of breaking it down; whereas, in the constant potential system this 3,000 volts is maintained constantly whether there is any power being used from the motor or not, even if the motor is driving itself solely. The heavy stress upon the insulation therefore, is constant.

The armatures are practically the same, because for the same speed and same field intensities, the number of convolutions and sizes of wire will be equal.

Let us examine the fields. Taking 3 per cent. of the total energy required in the fields, we have in the field of the constant current machines merely a series wire measuring 10,000 feet with a difference of potential at its ends of 100 volts, running 100 feet to the volt, being a large wire easily handled and one that will withstand shocks, jars and rough handling indefinitely. Taking the same number of square mils per ampere for the wire in the field of the constant potential machines, we find that an extremely small wire has to be employed. We find that this wire must be 62 miles in length; we find that the difference of potential between each successive layer upon the fields is 200 times that which exists in the constant current fields, taking at least forty times as long to wind the same. This great increase of potential difference between the successive layers should require double covered wire. Let us see what bearing this has upon the case. With double covered wire of this size the ratio of insulation to copper would be 44 per cent., whereas in the constant current the ratio of insulation to copper is only about 3 per cent. This re-

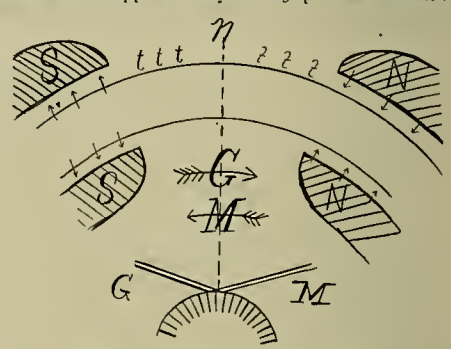


FIG. 2.—OPERATION OF ELECTRIC MOTORS WITH HIGH TENSION CURRENTS.

quires about 40 per cent. more field space in the case of the constant potential, which means a larger machine as compared with the constant current generator. The actual net cost, pound for pound, of wires in this instance would be $3^1/_3$ times as great in the constant potential as in the constant current machine, making the total cost of insulating wire for the field of the constant potential machine over four times that of the constant current machine.

These details indicate plainly impracticability on the part of the constant potential and perfect practicability in the case of the constant current. This impracticability is not decreased as the complexity of the machine is increased by being compounded or over-compounded. In fact, an eminent writer on constant potential machinery, no earlier than November last, in discussing a pressure of only 1,000 volts states "that where high pressure generators are used, it is very expensive to wind a shunt field of high enough resistance to stand the electromotive forces of the armature. It is much cheaper to wind a shunt field for low pressure, say of 110 volts, and separately excite it by a small constant potential dynamo." This, of course, would add to the plant another item of expense which would be slightly more expensive though far more practicable than the field winding described above on the 3,000 volt basis.

In the practical operation of constant potential motors, the use of an artificial resistance is imperative, by means of which the lack of counter electromotive force in the armature of the motor, as the speed starts and increases to the normal, is made up by dead resistance. This resistance for large motors occupies much space and in case of high potentials is expensive. In the constant current plant, however, a switch shunting the motor is opened and there is at once thrown upon the motor only its normal amount of current, and as the same starts and its counter electromotive force increases, the electromotive force of the generator also increases in proportion, until its normal speed is reached, without at any time any increase of current whatsoever or tendency to burn. On the other hand, with the constant potential should an accident happen and the machinery be brought to a stand suddenly, there is serious danger of overheating and burning the coils of the armature and series coils of the fields. In this emergency the constant current is cared for automatically by the regulator on the generator which diminishes the potential upon the line, correcting the current intensities almost instantaneously. Upon both constant potential motor and generator as the load increases and diminishes a manual adjustment is also required to keep the brushes on the non-sparking point

It is found in practice that if constant potential motors, as ordinarily constructed and connected in circuit, are belted to the same shaft or otherwise connected to the same work so that they must revolve together the result obtained is unsatisfactory because of the fact that the load will be unequal and

[1]Read before the Chicago Electric Club, February 3, 1890.

disproportionally divided. This is due to the fact that it is impossible to construct two electric motors, the armatures of which, shall have precisely the same counter-electromotive forces, therefore if two motors coupled together in this way are supplied from the same main the armature which produces the lowest counter-electromotive force will take a larger current than the other motor. The effect of this increased flow is to greatly exaggerate and enhance the difference existing between the motors because the fields of the motors are disturbed by the increased flow and its counter-electromotive force is still further reduced resulting ultimately in burning or destroying one of the motors.

Prof. Rice has recently devised a system to overcome this effect, but at best it is complicated, and still further increases the complexity of the machine. Another way would be to run each motor connected to a separate generator with separate line wires, but this, to say the least, is expensive. Any number of constant current motors may be attached to the same power; in this case their regulators are dissimultaneously operating. Having thus pointed out some of the differences, let us look into the stations provided with these two sets of apparatus. In the constant potential generating station we find a very large machine. Upon the wall are an ammeter, a voltmeter, a large rheostat for controlling the fields, and most probably an exciter and duplicate set of station instruments. Connected with the exciter, at the motor end of this line, we find the motor, a large rheostat and probably another exciter. Going over now to the generating station of the constant current machine, we find an automatic generator which is smaller than the constant potential machine. On the wall we simply find an ammeter. At the motor station we find a motor supplied with a small and durable mechanical regulator for its fields or preferably for its brushes, and perhaps an ammeter upon the wall. This constitutes the entire plant; nothing about it but what can be easily comprehended and successfully operated by an engineer of ordinary intelligence, and we observe an entire absence of complexity of connections in the machines, or circuits running back and forth from the machine to the various devices upon the switch-board or wall; and the first cost and cost of installation of these various devices is decidedly in favor of the constant current system.

It may be said that some of the objections above will be eliminated by reducing the e. m. f. of the constant potential plant. Let us reduce it one-half, that is, to 1,500 volts. Now, it is true that the fields are less difficult to wind, the length of the wire is less and the wire somewhat larger, enough so, perhaps, to do away with the necessity of an exciter. An increase, however, will have to be made in the size of wire on the exterior circuit. The current is now increased to 37½ amperes, and for the same loss in the exterior circuit the wire will have to weigh 14,000 pounds instead of 4,000, costing $2,800 in place of $800; and if the potential is still further reduced to 1,000 volts, in which case there would be 56¼ amperes, the wire would weigh 18 tons and cost $7,200, as compared with $800, for the constant current plant, with poles in the former, at much less intervals and heavier construction all through.

It is hoped that free discussion will be had upon these points and that additional facts may be developed which will aid in arriving at the most direct method of distributing power electrically.

Electric Limited Train.

Two extra sleeping coaches are to be added in Chicago to the "Electric Limited" train by which delegates to the National Electric Light convention will go to Kansas City, Feb. 10th. A large number of applications for berths in these coaches has already been received. Western delegates, who have not already done so, should make application at once to W. W. King, city passenger agent of the C., B. & Q., Clark and Adams street, Chicago.

New Valveless Compound Engine.

The principal features of construction of the Triumph compound engine are herewith illustrated. The machine is valveless and a leading feature is the simplicity of its construction and the interchangeability of many of the parts. Fig. 1 is a vertical longitudinal section through the engine. Fig. 2 is a vertical cross-section; Fig. 3 is a horizontal cross-section through the

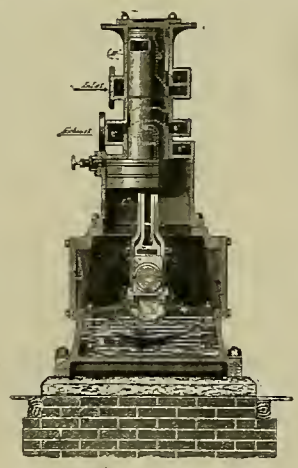


FIG. 2.—NEW VALVELESS ENGINE.

live steam ports; Fig. 4 is a horizontal cross-section through the expansion ports, and Fig. 5 is a front view of the engine complete.

H' H'' H''' are high pressure and L' L'' L''' are low pressure cylinders and the pistons acting in each will be referred to by the same letters. The pistons are connected directly to the shaft by connecting rods without the intervention of piston rods and the cranks are set at an angle of 120° with each other, in which position all the moving parts, which consist merely of pistons, connecting rods and shaft, are perfectly balanced.

Pistons H'' and L'' are shown on the upper center, pistons H' and L' being 120° in advance and pistons H''' and L''' 120° in the rear. In this position live steam is admitted from the main steam pipe, a which is connected with the boiler, through port, b', pipe a' and port, g'', to cylinder, H'', and at the same instant, steam which has been partly expanded in cylinder, H', passes down through port g', and pipe e', to cylinder L'', thus admitting live and low pressure steam on one set of pistons at the same moment. Under the action of the steam pistons H'' and L'' move downward, live steam being admitted until the upper edge of port g'' passes the lower edge of pipe a', at which point it is cut off and expands alone in this cylinder, until the lower edge of port g'', passes the upper edge of pipe, e'', at which point it passes to cylinder L'''. At the same moment live steam passes from a, through port b'' and pipe a'' and port g''' to cylinder H'''. At this point, also, piston H, moving upward, closes the connection between cylinder H' and L'' and the steam expands alone in L'' for the remainder of the stroke. As piston L'' reaches the lower center, port d', comes opposite pipe e', and the exhaust steam passes through this connection into pipe e, which communicates with the atmosphere or condenser. When piston H' reaches the upper center live steam passes from a, through port b''', pipe a''', and port g', to cylinder H' and the partly expanded steam, passes from cylinder H''' down through port, g''' and pipe e''' to cylinder L'. Cylinder L''' exhausts through pipe, e'', port d'' into e and cylinder L' through pipe e''', port d''', into e. X is merely a live steam connection with the low pressure cylinders for heating up and starting. Thus with the exception of the cut-off each set of pistons controls the steam in the cylinder next preceding, in the order of rotation, and when acting as a valve is at or near its maximum speed, while the pistons in the preceding cylinders are at or near their slowest speed.

All lubrication is perfectly automatic, consisting of a sight feed lubricator on the steam pipe, a drop sight feed cup on each end bearing of the shaft and a mixture of oil and water in the crank case, perfectly lubricating all parts within. The cylinders are cast in one piece and bored at the same time on a tool especially designed for the purpose, by which means they are made absolutely parallel and the danger of leaky joints avoided. The bearings for the shaft are bored out while bolted in place, insuring perfect alignment, and all wearing surfaces are exceptionally large so that internal friction is reduced to a minimum. The only adjustments consist of two keys on the connecting rods which take up all the wear in both boxes. The pressure being always downward these adjustments are seldom necessary. The machines are manufactured by the Triumph Compound Engine company, Cincinnati, O.

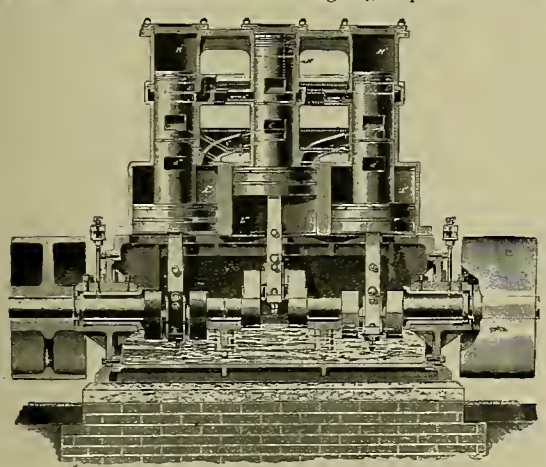


FIG. 1.

FIG. 3.

FIG. 4. NEW VALVELESS ENGINES.

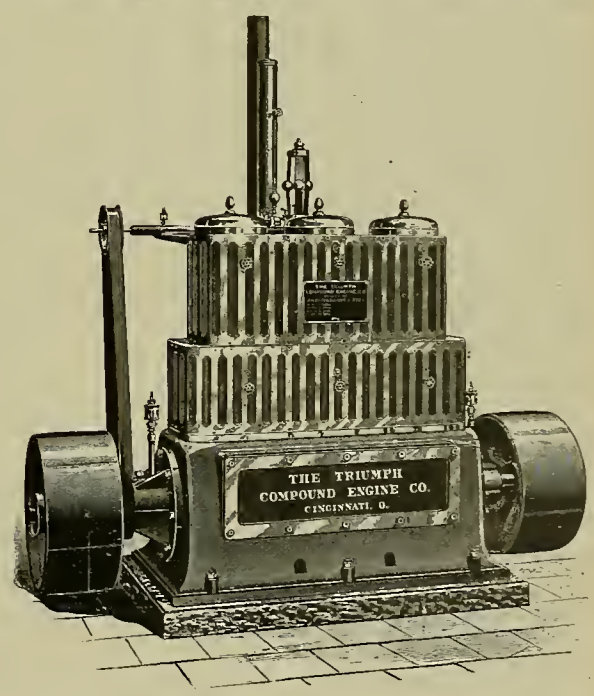


FIG. 5.

It was the intention of the Joliet, Ill., street railway to formally start the electric cars on Feb. 3, but while making trial trip the evening before the electric cars were stopped by the sheriff and another injunction was served on J. A. Henry, the president of the company. The injunction was taken out by the Chicago & Alton railroad restraining the street railway company and the Thomson-Houston company from running the cars or charging the trolley wire with electricity, because the wire was placed at a less height than twenty-five feet above the Chicago & Alton tracks. At present the wire is about twenty-three feet above the railway crossings, and it is claimed that if it is placed at a height of twenty-five feet the trolley pole on top of the electric car will not reach the wire. The action of the Chicago & Alton is causing much unfavorable comment.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 125 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE Ohio legislature is considering a bill which has for its object the protection of the traveling public. It prohibits, under fine of $25 to $100, the employment of train dispatchers or railroad telegraph operators for other duties than those connected directly with their instruments.

REPORTS are all to the effect that the convention of the National Electric Light association at Kansas City next week will be of the most successful character. In an article in another column is given the latest news in regard to the meeting. Secretary Garratt in a letter addressed to the members of the association, asks them to provide themselves with credentials from companies which they will represent at the convention.

THE electrical commission of Cleveland, O., which has for several months supervised electrical constructions, suddenly found itself without power last week. The commissioners discovered that their orders had been disregarded in several instances. They applied to the police authorities for assistance and asked for the apprehension of those who were guilty of action contrary to instruction. The police refused to make arrests, as the officers held there was no authority vested in the commission which enabled them to enforce their orders. The electrical commission was appointed by the local board of improvements, and received its authority from the latter. The electrical companies generally applied to the commissioner for permissions and usually followed its recommendations. Since it has been asserted that it has no right to enforce its orders, it has decided to have all its future proceedings referred to the board of public improvements for approval, and institute measures to secure a legal existence.

IN the last number of the WESTERN ELECTRICIAN was published Prof. Anthony's interesting paper on "A Review of Modern Electrical Theories." In the present issue is given the first instalment of the discussion which followed the paper. A great many interesting points were brought out. Attention should be particularly called to Dr. Moses' remarks which constitute of themselves a paper of more than ordinary merit.

AN article by C. L. Imhof in this issue on "New Features in Dynamos," is of more than usual interest. Mr. Imhof states that the horns of the pole pieces of opposite polarity may be magnetically connected without short-circuiting the magnetic lines of force. The advantages which it is asserted follow from the magnetic connection are that the induction in the armature is increased and diminished gradually, and that eddy currents are avoided. The result is a sparkless commutator.

IN one of his letters "Gath" quotes Hector de Castro, one of the managing men of Mackay's Telegraph company, as saying: "They have made a precious mess of it in New York attempting to bury the telegraph wires with a political commission. They should, in the first place, have constructed an ample underground viaduct big enough for a man to walk through it. As it is, they have deranged the business of every body, multiplied disasters and got nothing for the money. The politicians have been growing fat at the expense of the corporations and the people."

IN the Boston letter this week considerable space is devoted to the subject of legislation on electrical matters in the Massachusetts assembly. It is remarkable how many electrical measures, good, bad and indifferent, are now under consideration in state legislatures. Doubtless this subject will receive considerable attention at the convention of the National Electric Light association next week. The fact that legislation on electrical matters is becoming so common shows how timely is the earnest work of the association's committee on state and municipal legislation.

ANOTHER murderer has been sentenced in New York state under the electrical execution law. Joseph Chapleau was found guilty of murder in the first degree at Plattsburg, and was sentenced to die at Clinton prison. It will be remembered that a clause in the electrical execution act provided that newspapers should not publish accounts of executions beyond giving the mere statement of fact. The New York papers generally found fault with the provision. Last week an amendment was introduced in the New York state senate which contemplates a modification of the law, making it the duty of the agent and warden of the prison where the death sentence is carried out to be present and to invite, by at least four days' notice, the presence of a justice of the Supreme court, the district attorney and the sheriff of the county where the conviction was had, two physicians, twelve reputable citizens, and seven assistant or deputy sheriffs. This provides for the admission of reporters and the description of the execution, as was done at hangings. When he was in Rochester, N. Y., recently, Mr. Brown expressed to a reporter his entire confidence that the Court of Appeals would find the electrical execution act constitutional. The case will be argued February 24. When asked whether he would attend the first execution, he replied in the negative. "He would like to," he said, "but there had been so much newspaper gossip about his connection with the matter so far, that he preferred to keep in the background at that time. Some papers," he said, "had asserted that it was in his contract with the state that he was to superintend the execution. The law makes this the duty of the warden of the prison." Mr. Brown said "There was no foundation for the charge that death by electricity was a cruel punishment, and there would be no foundation for such a claim until a victim had succeeded in resisting the shock and afterward recovered so as to give an account of his sufferings."

AT the last meeting of the Chicago Electric club, Elmer A. Sperry read a paper on the "Operation of Electric Motors with High Tension Currents." The tenor of the paper, which is presented elsewhere in this issue, is in favor of the constant current motor. Mr. Sperry first points out that there can be no question as to the utility and great advantage of employing high potentials in power transmission. He follows this statement with a discussion of the relative merits of the constant current and constant potential systems. An example is taken of two similar plants operating at the same high potential; but one supplying a constant current and the other delivering current at a constant pressure. The generator and motor of the two systems are considered. Mr. Sperry asserts that the centrifugal governor can be constructed to such a degree of sensitiveness that, through its use, the constant current motor may be held within the same speed limits as where shunt or compound winding is employed. He advocates the method of government by rotating the brushes by means of a centrifugal device, about the commutator between the points of zero and maximum potential. That the commutator may be sparkless in constant current work Mr. Sperry points out that from the maximum to the minimum point of potential, the brushes must always be handled in the direction they point. Numerous other advantages of constant current power distribution are presented. In the discussion which followed, the constant potential motor received its share of attention, and a number of important points in its favor were brought out.

WHATEVER Sir William Thomson writes is of interest to every electrician. At the present time, however, an article from his pen, which is published in another column in this issue, is of special significance. His subject is that which has provoked no little controversy during the last few months—"Electric Lighting and Public Safety." The article is brief, and relates particularly to England. He takes up the English board of trade electric light regulations. These regulations, he asserts, if thoroughly and permanently fulfilled, will effectively secure the protection of the public. In speaking of the location of circuits, he says it has been resolved in all the large cities of the United Kingdom that the distribution shall be underground. The exception to this rule is the telephone system. These wires are to remain in the air, and as Sir William says, "Long may they hold their place there." Doubtless the telephone companies will say amen. In the country the distribution must be overhead, says Sir William, as the cost of putting the wires underground would prohibit the use of electric light. The regulations of the board of trade are, he thinks, an ample guarantee against danger in country districts; in fact, he thinks they may be relaxed somewhat. If strong wire guyed poles are used and the spans from pole to pole are short enough, he thinks bare copper wire can safely be used. Still he is not ready to advise at the present time any relaxation of these rules. Before that is done the possibility of insuring the security of poles and wires at a moderate cost, must be demonstrated. The timely expression of opinion by Sir William Thomson will, it is to be hoped, be widely read. The common sense opinions expressed by him should tend to correct many of the erroneous ideas which have obtained especially of late, on the dangers connected with electric lighting. The authorities in a great number of small towns throughout America who are at the present time seriously considering the question of forcing local companies to bury their wires can find an immense amount of good solid advice condensed into a small compass in the article.

New Features in Dynamos.[1]

By C. L. Imhof.

The efficiency of dynamos is always decreased by the induction caused in the stationary pole pieces by the revolving armature, by the self induction in the armature coils and the sparking of the brushes on the commutator.

These faults are especially noticeable in dynamos having armatures of the Brush and Weston types, with projecting teeth on the cores. In consequence of the varying position of these projecting teeth in relation to the pole pieces, the intensity of the magnetic field will be subjected to periodical undulations; these again will produce induced currents in the coils and cores of the field magnets.

In order to avoid these interferences Wenström and

Fig. 1.

Fig. 2.

Brown put the wire coils of the armature not in grooves between projecting teeth, but in longitudinal holes, Fig. 1. Crompton and Swinburne use the same method in their alternate current dynamos, and claim as a result a steady current and little heating. Lahmeyer puts the wire coils in grooves, and then winds a thin layer of iron wire over the armature, Fig. 2.

During the exposition of devices for the prevention of accidents in Berlin, a new dynamo was exhibited by the Allgemeine Elektricitaets Gesellschaft, in which the faults mentioned were entirely avoided. Although the early method of building dynamos with little iron and much wire

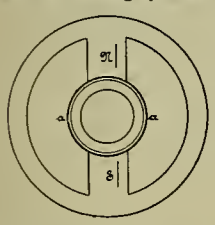


FIG. 3.

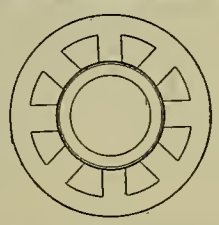


FIG. 4.

was abandoned a long time ago, and to-day, imitating foreign countries, we use enormous masses of iron in the field and armatures, there still prevails the idea that the horns of the pole pieces must not surround the armature for more than two-thirds of the circumference.

Contrary to this idea in this new dynamo the pole pieces are magnetically connected by a closed iron ring *A*, Figs. 3, 4 and 6.

Fig. 3 shows this method for a two-pole machine, and Fig. 4 for a multipolar dynamo. Instead of being connected by an iron ring, the pole pieces may be cast in one solid piece, and then be bored out for the armature, Fig. 5.

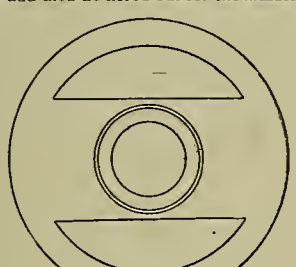


FIG. 5.

In order to prevent the magnetic lines of force from being short-circuited from pole to pole, a number of holes are bored which decrease the cross section of the iron materially in the "neutral" line, Fig. 6.

These new features are minutely described in the German patent No. 47,757. It states that these improvements are made for the following purposes: "To utilize the magnetic field to the best advantage, to obtain an even and gradual change of polarity in the armature, in order to avoid Foucault currents in the armature and field cores, and in order to decrease the self-induction in the armature coils when passing the neutral line, and to decrease the sparking on the commutator caused thereby."

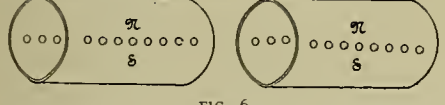


FIG. 6.

Imhof designed in 1883 a dynamo in which the horns of the pole pieces formed a ring which was slit in the neutral line, as indicated in Fig. 7. The slits were made oblique, so that a "gradual" change of polarity in the armature would be the result. Imhof did not take a patent, as he found that Niandet and Raynier had a German patent No. 16,629, on connecting the poles of electro-magnets, Fig. 8, by means of a thin iron ring. This ring, of course, must be of a small cross-section, smaller than the cross-section of the iron cores of the field magnets, otherwise the ring would form a "keeper" for the magnets. The thin iron ring may be put on the poles of either one or more stationary magnets, Fig. 9. The result is approximately the same when the ring is placed over the movable poles.

This thin ring must not be confounded with the extensions which are attached to the pole pieces of some dynamos. These solid wrought or cast-iron extensions, Fig. 10, cause a very different result than that following the use of thin iron rings. By means of the ring, Fig. 11, a rational distribution of the magnetism is obtained. The magnetization on the line *N N* is zero and increases to poles *A* and *B* to the maximum. The induction on an

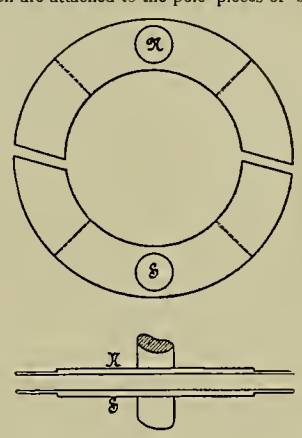


FIG. 7.

FIG. 8.

electro-magnet, moving from position 1 along the iron ring, is gradually increased until it reaches position 2; from this point the induction gradually decreases until the electro-magnet reaches position 3, where it again becomes zero; then again the induction gradually increases to a maximum in 4 and decreases to zero again in 1. Fig. 12 shows the arrangement of the ring with radial electro-magnets.

Train Lighting by Electricity.

The Safety Car Heating & Lighting company of New York city, which has acquired the rights of introducing the Pintsch gas lighting system in this country, recently announced that the

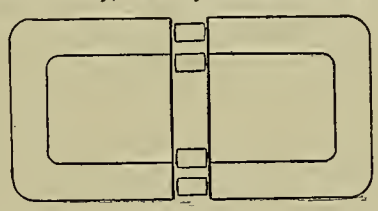


FIG. 9.

Pullman company had adopted this system and would introduce it in its vestibule trains in place of electric lights which are now used. An exchange says: "One of the most important railway improvements of the time is the lighting of drawing room and sleeping cars, as well as ordinary passenger coaches, with gas under the system known as the Pintsch light. The dangers of kerosene are thus averted, and the electric light superseded. So long as the storage battery remains in its experimental stages, the Pintsch method excels all others, both in brilliancy and

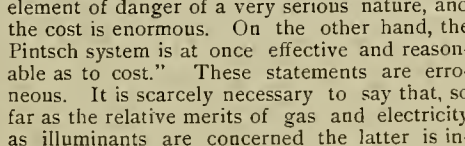


FIG. 10. FIG. 11. FIG. 12.

convenience. Even storage batteries are heavy and unwieldy, while the wiring of the cars is an element of danger of a very serious nature, and the cost is enormous. On the other hand, the Pintsch system is at once effective and reasonable as to cost." These statements are erroneous. It is scarcely necessary to say that, so far as the relative merits of gas and electricity as illuminants are concerned the latter is incomparably superior. A. H. Bauer, electrician of the Pullman company, says in the three years which he has been using electric lights on trains he has not yet encountered the "element of danger" in the wiring of cars, nor has this claim been presented by the competitors of electric lighting before. As to the cost of the systems it may be added that it has been found much cheaper to utilize electricity. One instance will serve to illustrate this point. The L., N. A. & C. railroad recently ordered twenty cars from the Pullman company, and the Pintsch system was presented for consideration. So far from underbidding the electric company, however, it was found that the Pintsch system would cost $100 per car more than the electric lights, while the latter would furnish one-third more candle power. It is not anticipated, therefore, that gas will "supersede" electricity. It is furthermore contended that the system in its present state is not reliable. Only a short time ago a car on which it was being tried came into Chicago without any lights. The oil lamps had been removed, the gas system failed to work, and the passengers were compelled to travel the entire night in darkness.

Electric Lighting and Public Safety.[1]

By Sir William Thomson.

England and America are the freest countries in the world. Hence a remarkable feature of almost every city in the United Kingdom and the United States, which strikes with wonder all visitors from the continent of Europe—cirrus clouds of electric wire hovering perennially over the streets and houses. These clouds do not, to any sensible degree, diminish such light of heaven as the liberty-loving owners of domestic fire-places and steam-boilers allow to reach their fellow-citizens through the volumes of black smoke pouring from their chimneys. Some persons of taste object to the aerial wires as diminishing the beauty of our cities. The same people would complain of a forest of ships' masts seen from London bridge, or completing the vista of some broad avenue of New York, or relieving the dullness or the squalor of some little old city by the sea, if ships were an invention of this century and shipping industry not fifty years old.

Ruskin eloquently admires ships with their masts and sails as the most beautiful and picturesque of the works of man. Some future Ruskin will no doubt be equally enthusiastic about the beauty of the gossamer lines of telephone wire, with their gentle curves stretching away by hundreds from stately standards fixed aloft over our houses, or from high cathedral domes, or from future Eiffel towers, and ornamenting whatever they touch. Hitherto, however, conservative æstheticism has barred many cities of the continent of Europe from the larger benefit of electricity in the service of man already enjoyed by America and England; and would, in England, if it were permitted, sweep all electric cobwebs from the sky, and not concern itself with the question of expense involved in banishing all telegraphic, telephonic, and electric light wires to below ground.

Public work in most cities of Europe is tremendously under authority, and, as a rule, authority, except in America and England, is very timid, even in respect to matters of taste. The more serious questions of public safety which the large development of the high pressure alternate current system with transformers for electric lighting has forced upon us, in the last four years, have scarcely hitherto come into account in determining the rules and usages of continental cities as to overhead and underground wiring.

In Paris, the electric lighting companies, bound under stringent regulations of the city authorities, have all their conductors underground. There are no exceptions to this; nor are there any overhead telegraph wires. Both telegraph and telephone wires are insulated in electric cables, and are placed underground in the excellent sewer system of Paris, except in some very rare cases where a subscriber lives in the outskirts of the town, and has an air-line to the nearest point of a cable-carrying sewer.

In Berlin, all the electric light wires are underground, and the lighting is all done by continuous currents at low potential, much of it for out-of-doors, by arc lights in bridges of pairs, between conductors for the supply of indoor lighting, by Edison 100-volt lamps. No rules have been laid down in Germany to provide against personal danger, there being practically none to provide against with 100-volts' potential; but rules to prevent danger from fire are imposed on makers and users of electric light installations.

In Belgium, the telegraphic department issued, in 1887, a careful code of rules for the establishment and use of electric light wires above ground in all parts of the Belgian dominion, and especially in the neighborhood of telegraphic and telephonic lines. Not one of these rules has reference to possible danger from conductors at high potential, because, in fact, in Belgium, as in Germany, there have been hardly any high pressure electric installations of alternate current with transformers, and electric lighting work has been done chiefly by continuous currents at 100 volts or other low potential.

In Italy there is no law restricting electric industry. In Milan and many other towns of Italy there are small stations for electric light, supplied through underground wires at low potential. In Milan and Turin there are installations of aerial wires at 2,500 volts for forty arc lights in series. These isolated installations have no doubt been put up with great care, and do not seem to have been hith-

[1] Translated for the Western Electrician from an article in the *Elektrotechnisher Zeitschrift*.

[1] *North American Review*.

erto found dangerous to the public. A grand installation for electric light in Rome, by water power of the Tivoli Falls, at thirty-seven kilometers' distance, is now projected and will no doubt be realized before long. It is designed to use 2,500-horse power at the falls, which is to be transmitted by alternate current, at 5,000 volts, through aerial conductors over the country to the city gate. There, by a transformer, it is to be first reduced to 1,000 volts, and distributed by underground supply conductors to numerous transformers in different parts of the city, by which it is to be further reduced to the safe 100 volts for use.

In passing, I may remark that 100 volts in the house is perfectly safe to the user, whether the current be alternating or continuous, as is proved by large and varied experience in England.

There is, so far as I know, just one city in the world, outside of England or America or Italy, in which high pressure overhead wires are used, and that is Temesvar, in Hungary, which has been thus supplied with electric light for many years.

In England, any individual or company wishing to carry wires above the houses and streets of our towns, or anywhere over the country, and having obtained permission from the proprietors to place the requisite bearing poles on roofs or other parts of buildings, or on unoccupied ground, has perfect liberty to do as he pleases in the air over town and country; provided that he comply with whatever conditions may be prescribed to protect the public safety and the convenience of previous occupants of the air.

Two years ago the Board of Trade issued, under the electric lighting act of 1888, very stringent regulations for safety, to be observed throughout the United Kingdom, in every case of placing an electric conductor otherwise than wholly inclosed within a building. They have been approved by the Institution of Electrical Engineers in consultation with the officials of the Board of Trade. If they are thoroughly *and permanently* fulfilled in every case, I believe their object—"the protection of the public safety and of the lines and works of the postmaster-general, and of other electric lines and works"—will be effectually secured. So much being admitted—and I believe so much will be generally admitted—the question remains, "Can these regulations of the Board of Trade be thoroughly and permanently fulfilled?" All that is essential for public safety is provided for in regulations 1, 3, 7, and 9. [These are printed at the end of the article.]

Regulation 3 places a problem before engineers which is certainly not beyond their powers of fulfilment. The bearing poles and standards, the strength of the porcelain insulators, and the tensions of the wires can certainly be so arranged that the whole structure of a set of aerial conductors will be as safe against breaking down as any railway bridge.

Under regulation 7, it may be remarked that the "crossing conductor" is the invader of a previously occupied aerial province. The fulfilment of rule 3 by both the previous occupant and the invader secures, *ipso facto*, the fulfilment of rule 7. But rule 7 imposes on the new-comer—understood, no doubt, to be a provider of conductors for electric lighting—the obligation of guarding against an electric contact, even though the previously existing telegraph or telephone wires violate rule 3 and break down.

If rules 1, 3, and 7 are fulfilled, rule 9 is unnecessary, unless for the protection of birds. If the two conductors, side by side or one over the other, constituting the mains of a "high-pressure" circuit of 2,000 volts, say, or of 10,000 volts, be bare copper, it would be instant death to a bird standing on one of them to touch the other with tail, wing, or beak. But no other creature could be endangered by bare aerial conductors, even at 10,000 volts, if they fulfil rules 1, 3, and 7. The protection of birds was certainly not thought of by the Board of Trade and we infer that rule 9 implies a suspicion that the fulfilment of rules 1, 3, and 7 may occasionally fail in practice. The fulfilment of these rules can, indeed, be made practically certain. *But at what cost?* What of the cost for permanent maintenance of standards, suspending wires, "non-metallic ligaments?" And what of the "durable and efficient material" required by rule 9 as an insulating coating for the copper conductor, when we consider that every hitherto known insulating material that could be used for coating the wire experiences destructive deterioration in the course of years, especially if kept exposed to light and to the variations of outside atmosphere in our climate?

We are forced to conclude that in laying down these regulations, and in arranging for careful inspection to secure their fulfilment as far as practicable, the advisers of the Board of Trade felt the danger from high pressure overhead wires could not be absolutely annulled. This view is confirmed by the fact that in most or all cases in which provisional orders under the electric lighting act of 1888 have been granted to companies for the electric lighting of cities or districts of cities, it has been stipulated that the conductors shall be altogether underground, except in cases in which aerial wires have already been placed and brought into action; and that even in these cases the conductors, if for high pressure supply, shall be removed from the air and replaced by underground conductors within two years.

It may be considered, indeed, as now definitely resolved that the distribution of electric energy for light and power in towns of the United Kingdom shall be by underground conductors, and plans for carrying this into effect safely and economically are engaging the anxious consideration of electrical engineers. The telegraphic department of the postoffice has already replaced nearly all the aerial telegraph wires of the larger cities by underground conductors.

The telephone wires alone remain in the air. Long may they hold their place there; they are perfectly harmless to the general public, and they are enormously less expensive where they are than they could be if placed underground.

As for the country, telegraph, telephone, and electric light conductors must all be in the air. The cost of placing them underground would be absolutely prohibitory of the great public benefit to be obtained by placing more and more of them in the air. The Board of Trade rules given herewith are amply sufficient guarantees against danger to man or beast in country districts, from aerial electric light conductors, whether for high or low pressure; high pressure they must generally be for long ranges over country. Indeed, I believe these regulations may be largely relaxed for electric light wires in the country. Provided only that strong enough and sufficiently well-engineered standards or well-stayed poles be placed for carrying the wires, and provided the spans from standard to standard be short enough, it will, I believe, be found quite unnecessary in respect to public safety to have any cost of insulating material on the copper of conductors for electric light or power along a country road. Fifty years may well pass, with all their gales and snow storms, without a single breakdown, and there are no telegraph or telephone wires to fall upon the deadly copper with its 10,000 volts. Until, however, the security of the poles and wires, which I believe to be attainable, is satisfactorily demonstrated, and until it is also proved that this security can be attained at moderate enough cost, I would not suggest the slightest relaxation of any of our Board of Trade regulations for the protection of the public safety, whether in town or country.

The rules to which Sir William Thomson refers are as follows:

1. An aerial conductor in any street shall not in any part thereof be at a less height from the ground than twenty feet, or where it crosses a street, thirty feet, or within six feet of any building for the purpose of supply.

3. Every support of aerial conductors shall be of a durable material, and properly stayed against forces due to wind pressure, change of direction of the conductors, or unequal lengths of span, and the conductors and suspending wires (if any) must be securely attached to insulators fixed to the supports. The factor of safety for the suspended wires shall be at least six and for all other parts of the structure at least twelve, taking the maximum possible wind pressure at 50 pounds per square foot. No addition need be made for a possible accumulation of snow.

7. Where any aerial conductor is erected so as to cross any other aerial conductor or any suspended wire used for purposes other than the supply of energy, precautions shall be taken by the owners of such crossing conductor against the possibility of that conductor coming into contact with the other conductor or wire, or of such other conductor or wire coming into contact with such crossing conductor by breakage or otherwise.

9. Every high pressure aerial conductor must be continuously insulated with a durable and efficient material, to be approved by the Board of Trade, to a thickness of not less than one-tenth part of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulation must not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000. This insulation must be further efficiently protected on the outside against injury or removal by abrasion. If this protection be wholly or partly metallic it must be efficiently connected to earth, so, however, as not to cause undue disturbance to other electric lines or works by electrostatic induction or otherwise.

Acoustic Principles Underlying the Art of Telephony.

At the meeting of the New York Electric club January 16th, Prof Charles R. Cross of the Massachusetts Institute of Technology made an address on "Acoustic Principles Underlying the Art of Telephony." After giving a large number of simple experiments which illustrated the principles of acoustics, Prof. Cross continued his address as follows:

If, then, we are going to reproduce quality, we must reproduce these various elements that I have spoken of. If we reproduce quality by an acoustic telephone, like the lover's telephone, which I have here, of course it is merely necessary to have a membrane to take up the vibrations produced by the voice, which communicates its little pulls and relaxations of pulls to the string, which acts upon the other membrane and reproduce corresponding vibrations.

Suppose we have to do this electrically—we have to do what was suggested in 1854 by Bourseul. We must have a disk capable of taking up the vibrations of speech from the air at one end of the line, and at the other end of the line a disk which is so excited by electricity as to vibrate in substantially the same manner. The air at the transmitting station is caused to vibrate, and you reproduce, at the receiving station, the speech produced at the transmitting station. But how to make use of electricity was not suggested. That, of course, was going but a very little way, but it seems to me to be deserving of a great deal of credit, it being the first instance in which any one, in a distinct published statement, seemed to have appreciated the physical and acoustic conditions which must obtain in order to reproduce speech.

But we see that we must go very much farther than this, because we must find in some way how to bring about the vibration of the diaphragm at the receiving station. Can we do it by simply making and breaking the circuit at each principal vibration? Making and breaking the current thus can simply give you the pitch—simply produce at the further station a note of the same pitch as that which is produced at the transmitting station. Considering simply the opening and closing of the circuit and nothing else, it can do nothing further, because the diaphragm or disk is merely pulled in the one direction when the circuit is closed, and released when the circuit is open, so that motion takes place in the opposite direction—a sudden violent pull, and an equally sudden release. You can reproduce thus a note having a pitch identical with the pitch of the sound at the sending station. It cannot reproduce the intensity. It does not and cannot reproduce the amplitude of the form, because all of these variations of the curve [indicating] are obliterated. You simply have the rate of motion determined, whatever the vibration of the diaphragm may be, while the circuit is broken or while it is made, is really of no account. Suppose we can arrange it so as to make and break on the partial tones. That seems very specious, but there is a fallacy underlying it which calls for notice. It is very easy to see if you think of a simple vibration like that. We will imagine some arrangement to make and break on each full vibration, and each overtone also, and reproduce those two partials, and thus reproduce the quality. Setting aside one important point, and admitting, for the sake of the argument, that you could do it with a tuning fork curve like that, what are you going to do with a curve having no sinuosities, like a curve from the organ pipe? Or, in a vibration representing the form of vibration of a violin string or a stop organ pipe rich in harmonics? Or, admitting that you can do the thing mechanically, you do not solve the problem. That is not the end of it. Suppose we admit that you do make and break the current as suggested. The sound produced by making and breaking a circuit a given number of times per second, has no relation to the quality of the sound of the instrument that produces it. It makes no difference whether it is the sound of a kettle drum, fife, the human voice or the tuning fork. If it is so many times per second, you will get one and the same sound from the receiver, providing you have only this circuit breaking action I am talking about. To illustrate by an experiment. Here is a tuning fork vibrating 128 times a second, giving a note identical with the resonator. Here is an ordinary telephone, whose circuit the same fork makes and breaks 128 times a second. The tuning fork, as you hear it, whose sound I can strengthen by bringing this resonator near the fork, gives us the quality of the sound characteristic of such a fork, which we are trying to transmit by circuit-breaking. Notice what the result is when we send the intermittent current through the telephone. You get a sound totally different in quality from that of the fork strengthened by the resonator. That which I have shown you to be true, so far as a single illustrative experiment can prove it, if true for the single note, must be true, however many partials you may have; you will simply have more of these wheezy sounds added to one another, and, undoubtedly, a greater noise, but nothing in any way resembling the original note. There is nothing peculiar to electrical action in that. You cannot use a set of ordinary sirens corresponding to a set of forks to reproduce sound. If you sounded the sirens you would not have the clarinet or the trumpet quality, because the impulses of air blown through a set of apertures such as are found in the ordinary siren, give a harsh noise. But if you use a wave siren—a disk having a sinusoidal curve cut on its edge, the air being blown against the disk through a little slit—you find that you do reproduce the quality of tone, and you can reproduce with one of these, as well as with the tuning forks, the quality of the various sounds.

To transmit speech we have got to produce electrical waves; we must throw the current into a state of change corresponding in rate to the pitch of the sound we wish to transmit, in extent corresponding to the intensity of the sound; and the form of the curve representing these vibrations must correspond to the form of the curve representing the sound vibrations which we wish to transmit. Whether we use variations in the electromotive force in the circuit, or whether we make use of a variation in the resistance, as with the microphone, or vary the capacity of the circuit, as in the unused condensing transmitter, makes no difference as far as the theory is concerned. If we can cause in these ways, or in any other ways that may suggest themselves, these variations in the strength of the current to take place, we can reproduce quality; if not, we cannot. You can have all variations of reproduction, from the greatest perfection to the reverse of that, but you will get perfect reproduction in proportion as you approach this condition of things.

I have sometimes heard the term, "electrical undulations," characterized by well-known scientific men. It has been said that we cannot properly speak of the waves of a substance regarding whose nature we know so little, as of electricity. The reasoning seems to me very false, although I have oftentimes heard it from persons from whom I should not expect to hear it. The early idea of the wave was the water wave; but in the case of water there was the up and down motion. When Mersenne and others studied sound waves two centuries ago, finding that the air particles went through a periodic change, such as we have seen in the particles of this model, they borrowed the term "wave" from the water wave, and applied it to the case in which you have a longitudinal motion of the particles, a condensation and rarefaction, there being a gradual passage from one phase, maximum condensation, to the other phase, maximum rarefaction.

Now pass to the current of electricity. Suppose you have a long line of air waves, and suppose that in some way you could congeal the air, freeze it, keep it permanently in its momentary shape; and imagine then you could have a little series of pressure gauges arranged along from inch to inch; or suppose you could tap off a portion of air and measure its density, you would get some sort of a curve. If it was the sound of a tuning fork through the transmitter, you would get some such figure as that.

Now, suppose you use a telephone and consider the distribution of electricity along the wire. You have variations in density from point to point; and suppose you use a set of electrical gauges, keeping the electricity in your imagination unchanged for an instant; suppose you could tap off little charges, a foot, or a mile or 100 miles (passing from inches of the sound wave), and find what the density is, and then draw a curve representing the density and making the scale of the two curves different, reducing the length of the horizontal line when we draw our electrical curve, in order to make up for the enormously greater velocity of electricity, and then draw another curve, the two curves will have the same form. [Indicating]. From such considerations it seems to me we could not ask for a fitter term to describe these changes than the expression "electrical undulations."

Incandescent Lamp Shade.

The shade illustrated in the accompanying cuts is designed especially for use in places where a more expensive porcelain or glass shade is liable to be broken or damaged. It is stamped out of a single piece of tin painted a light green on top, having underneath a bright tin or reflecting surface. The corrugations help to diffuse the light evenly, and give the shade a finish.

Fig. 1 illustrates a shade designed especially for the Edison socket, which it fits perfectly

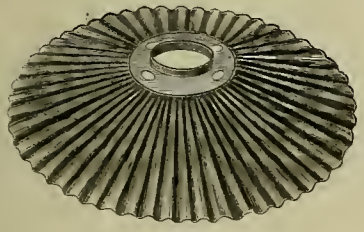


FIG. 1.

FIG. 2. INCANDESCENT LAMP SHADE.

without a holder. Fig. 2 illustrates a shade which fits any socket in the market. There is a brass collar closely fitted around the rim of the shade shown in Fig. 2, having adjusting screws arranged to securely fasten the shade to the socket. These novelties are introduced by the Central Electric company, Chicago.

A Review of Modern Electrical Theories.

PART I.

At the conclusion of Prof. Anthony's interesting paper on "A Review of Modern Electrical Theories," which was published in the last number of the WESTERN ELECTRICIAN, the following discussion took place:

DR. OTTO A. MOSES: I presume that all of us here have been very deeply interested in these speculations, because though they may be speculations, they are the scaffolding upon which the whole science of electricity has been based. It was the pursuit of a hypothesis that led Keppler year after year, through very patient investigations, to the results which revolutionized astronomy. The same course led Faraday, step by step, to those determinations which finally culminated in what we are now first recognizing—the identity of electricity and light. So that I can say that we have all been gradually accustoming ourselves to these speculations, even though many of us may be engaged in the practical uses of electricity. There are some remarks in Professor Anthony's very interesting observations to which I would like to call particular attention, more especially the last, as bearing upon our practical applications of the speculations. He spoke of the possibility of using the molecular action of gases as a means of transforming wave-lengths. If my memory serves that has been done ever since the Ruhmkorff coil has been in operation and the Geissler tube has become so perfect an analyzer of the electrical current. In that respect we have already anticipated some of these results. Let us consider what we already have. In the Geissler tube you have the attenuated gases; you have two disconnected poles; you have a current passing, and the wave-lengths broken up and the light produced. So that we have right there before us the facts. Whether we can ever utilize the Geissler tube so as to be able to effect these immense economies that the professor so pleasantly prophesied is a question to be determined. It has been experimented upon. I have found in my short experience in life that these things come when they are needed. There are certain groups of ideas that must be exhausted before people will adopt others and investigate them. We have seen it in the development of all the different branches of electric appliances. We have seen it in the telegraph. We have seen, for instance, Morse using Wheatstone's method of transmission; we have seen him abandon it. We saw him commence with underground conductors; we saw him abandon them simply because the art of that day was not perfect enough to allow him to apply them with profit, so that we can unearth many and many a theory now which already existed, but only awaited the development of the arts to be put into practice. There is one thing I would like to mention here with regard to the theory of electricity that may set our thoughts working still further. Could a child be born in this room and remain in it for the balance of his days, he never would for one instant conceive that this earth was moving with such enormous velocity as it does. It is simply by comparing it with other objects that it is possible for him to arrive at a conclusion. In fact, the world at large thought that this earth stood still until Copernicus changed their views. So that we can readily think that there are many and many applications that are only waiting for us to apply them by comparison with known things. These things have to be discovered.

Now there is one thing I would like to add as a brief supplement to Professor Anthony's predictions. It is in no critical spirit that I mention it, because I will be running somewhat counter to the mechanical hypothesis upon which he developed many of his remarks. One, with great humility, must undertake to oppose himself to a theory emanating from such a mind as that of Clerk Maxwell, but one of the difficulties in the minds of all great mathematicians is that they must put their thoughts into mechanical methods in order to be able to weigh and measure directly. If we could only divest ourselves of the idea that all nature is composed of molecules, we would then come into another range of thought. I see myself no necessity for imagining all nature split up into infinite particles—infinite in number, and infinitely small and large in size I can readily conceive of a continuity of matter In fact, that thought is of no novelty. It has been woven through all science, only we are so accustomed to limitations in our contact with nature that we are apt to conceive that those limitations actually exist beyond our mere perception of them. As Professor Anthony said very properly, there is an immense difference in our sense observations between a wave length of electricity and one of light, but that is no reason that there is not a perfectly insensible gradation from the wave of electricity into that of light. In fact, we see it when the current changes from heating effect into light. Why should we say that it is necessary to change suddenly from one point to another? Can we not imagine a wire six hundred miles long and vibrating and gradually commencing at one end and damming it up to the other end without a break? Why is it necessary to assume that there are nodes of vibration through it? Now, that leads me to a point which I think will furnish some food for thought. The wonderful analogy between the velocity of electricity and light is something that is no mere coincidence. It is true that light and electricity make themselves known to us through different senses—we have no electrical sense, to be sure, but through mechanical appliances we become aware of the existence of electricity; and through the mechanical operations on our retina we become aware of the existence of light. It is only a difference of degree, so far as that is concerned. If now we can conceive that there is an identity of cause, and I will throw out a hint here that I think may prove one step toward the solution. We are but a member of the solar system. The earth circulates with its sister planets around the sun. There is no doubt—it is admitted that the sun and its solar system are circulating around some other central point. We are utterly unaware of the speed with which we are going through space together with the sun. Now, I can readily conceive that the speed with which we pass through the sea of ether can be the speed with which light and electricity affect our senses. In other words I can readily conceive, and it does not require much stretch of the imagination, that we are passing through ether at a speed approaching two hundred thousand miles a second. If you consider that hypothesis it will immensely simplify the relations of electricity and light. We find that electricity is converted into light by two or three degrees increase of the transitory heat. A little below a thousand degrees light is invisible to our eye; a few degrees above a thousand it becomes visible; in both cases caused by electricity. So that electricity and light may be considered as having an identical cause. Now, that hypothesis of the most attenuated character, is one which I think should be dwelt upon, because it may lead finally to a solution of the question as to what is the cause of electricity and of light. Is it possible that this enormous solar system can be projected through space without our being able in any way to get evidence of the fact? We may be blinded to the facts; the facts may have existed as long as the knowledge that the world was moving around the sun existed, before it was determined. We may be blind, and that may be the medium by which we may arise finally at a determination of the identity of electricity and light. Now I will put a limit to the solar system's speed of circulation, but there are no doubt other systems within systems, and all the forces that operate upon us in nature may be the resultant of the varying speeds around different centers. Sir William Thomson's theory that the whole of matter can be summed up in a vibration is getting to be more and more well received. The fact that matter itself is simply and infinitely small vibration and circulation of atoms upon itself, leads us to believe that there are enormous forces at work, that change whatever it may be—ether or what not—into form. With that we must look for some enormous development of force to produce these results. Why matter should be chained to its place requires a conception of some enormous force acting upon it—a force greater than any that the minds of physicists have heretofore allowed themselves to believe to exist, and I consider that force to be based on some enormously increased velocity of circulation of the solar system. This may be somewhat wandering from the theme, but still it is a speculation drawn from a speculation, as an induction spark from one spark.

A MEMBER: There is one question I would like to ask in regard to the wheel hypothesis; that is, when you wish to increase the current of a conductor without increasing the heat wasted, it is necessary to increase the area of the conductor. Without knowing much about it, I should think that would increase the number of wheels inclosed in a conductor, and therefore increase the friction by increasing the amount of slip, and therefore increase the heat developed instead of decreasing it I am not very familiar with the theory, possibly I am making a great error, but it occurred to me that such would be the case.

PROF. ANTHONY: As I understand it, the more wheels there are in a conductor the less is the amount of energy spent in causing the slip over them, because you have got more surface for slips in it What we call a given current is accompanied by certain magnetic effects. That would mean that the wheels in space, inclosed by the conductor, are revolving at a certain rate. Now, supposing those all to be revolving at that same rate and increasing the size of the conductors and increasing the number of wheels there are in it, the wheels that are in the conductors will be set revolving at a less rate instead of a greater one, because there will be greater surfaces where the slip can occur. Whatever slip there is will occur over a larger surface, and consequently produce less motion.

PROF. M. M. GARVER: It is rather curious to me that in the matter of the heat developed in conductors, generally speaking, all the heat developed in the conductor, as Mr. Heaviside looks at it, is an action around the conductor. In that connection I cannot see, if it takes place around the conductor, why the law of temperature should hold as it does in the case of metals. Take for instance, the case of copper. I believe the variation is about two-tenths of one per cent. for 1° F. If the same law holds, for 500° there should be no resistance and no heat developed in the conductors. I believe some experiments have been made in regard to the conductivity of copper at very low temperature. I would be glad to hear from any one who has had experience in this line of investigation.

A. E. KENNELLY: There is one point, I think, that may be brought forward—that is the great difference between what might be called a working theory and an ultimate theory. Tracing back the history of any of the sciences as they are called to-day, we see how very widespread they were, how numerous the sciences were, how in the Greek days every activity, the motion of a cloud, the motion of a body in the air, or of a body leaving the hand, was supposed to proceed from some superior cause. Gradually, as knowledge increased and as investigation pursued its quiet path, those forces were singled out and found to be fewer and fewer, and to-day we stand with a certain number which we still hope will be reduced and finally embodied in one. Dr. Moses has given us a very beautiful, I might almost say a poetic view of what he calls the infinitude of nature, but I think it would be a finer expression, perhaps, if he will allow me the correction, that infinitude be considered as proceeding rather from the unity of nature. In fact, if we go back to the days of polytheism, the old Mahometan cry "There is one God" stands very aptly by comparison In the theory of heat, for example, there were what we call now the crudest notions prevalent about 400 years ago as to what its nature might be. Slowly those views have become clearer, and now, perhaps, heat is in its theory more complete than any of our other sciences. But the trouble with heat has been the same as it is now with electricity—the difficulty of getting first a theory that was workable and then a theory which would account for the facts clearly and consistently We have listened to the explanation of a beautiful theory, a theory worthy certainly of the master minds that originated it, but somehow it does not appear as though that theory were going to be the ultimate one which would satisfy us when we come to consider nature as a whole, and although it is a good working hypothesis—a peg upon which we can hang our thoughts—after all, we may hope for some better, some clearer, some simpler and more universal distribution of matter than pulleys, and spinning wheels in space. When a vacuum was supposed to be the absence of everything from space, and nature, as we read in the old books, abhorred a vacuum, gradually people began to find out there must be something left, because phenomena, which took place in places that had apparently been divested of contents, could not be accounted for if there were nothing there, and I do not suppose that any of us have any other conceptions of a vacuum further than this one thing, that actions go on there through a space devoid of ordinary matter, which we cannot conceive of acting through nothing. Gradually as light came to be considered no longer on a corpuscular theory, it became necessary to invent a new ether and finally the question came again, if we unite the two ethers, will not the same ether do for both? Then came the electro magnetic theory of light and that required a special ether, and that again has been united. Now from the brilliant experiments of Hertz and Maxwell we see clearly that those two ethers are one and the same; at least, we cannot distinguish between their properties. The ether that we suppose will propagate light, is surely not one that we can readily unite with the idea of spinning wheels in space. The mere fact that the thing is difficult to conceive is no bar, of course, to its proof. But surely we are entitled to the expectation that nature in her infinity in infinitely simple. Surely it is in this ether that we have to investigate something which unites more readily the functions of gravitation of light and of electricity. If we have for example a large vessel full of incompressible fluid—water will answer—and we introduce into the water two little jets, small by reference to the whole vessel, and we cause the vessel to be hermetically sealed, full of water, with these two jets in it; then if we force water out of one jet, back through the other, causing a circulation to take place through the liquid, we shall find—with the one reservation that there shall be no vortex motion in the liquid, that all the particles shall advance in

ranks, shoulder to shoulder, and eyes front—the lines that will be pursued by the individual particles are strangely enough, the lines which are followed, we have every reason to believe, by magnetism, by heat, in its permanent state, through solid bodies, and by gravitation. Surely there is some grand principle underlying that great class of phenomena, which some day in the future will join them all into one coherent mass by which we shall see not only electricity, but all the other forces of nature united.

The point that the gentleman close by me mentioned about the conductivity of copper at a very low temperature is one which has certainly a very great practical interest, although we are not likely to be able to live in a climate where for the sake of our conductors we can submit to two or three hundred degrees below zero. But I think that the experiments that have been made, and I have no doubt others here will correct me if I am wrong—experiments have been made at minus 40 degrees centigrade, and they showed a very large increase in the conductivity of copper, and the coefficient of temperature was very much larger at that point than it was higher up the scale. The late Sir William Siemens had a very interesting theory in which he assumed that the resistance at a very low temperature was a limited amount which was very small indeed, and rose rapidly at first and slower and slower afterward. This is contrary to our orthodox views about conductivity of copper for high temperatures, but it is a view which is interesting in itself.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 1.—It looks as if the Board of Electrical Control would be given a new lease of life, as the political backers of that ornamental body have been hard at work at Albany in the interest of the board. The legislature will try to make a show of examining the affairs of the board, but will hardly go below the surface. This will of course have a tendency to prolong the life of that obnoxious institution. The sinking fund commissioners, under the present law, will assume control of the subways Nov. 1st. It was expected when this law was enacted that the question of underground construction would be settled in this city, and the work of burying electric wires accomplished or at least well under way by this time, so that the completion of the work could be safely left to the Sinking Fund commissioners. But to-day, so far as a practical solution of the problem in this city is concerned, the question is farther from settlement than at any period since the appointment of this mischief-making board. Nobody doubts that if the work of burying the wires was immediately placed in charge of the Sinking Fund commissioners and the Board of Electrical Control abolished, $25,000 or $30,000 would be saved in salaries and the work intelligently and earnestly pushed. The Sinking Fund commissioners would employ a competent man to actively supervise the work, as the Chicago authorities did, and it would be done in a manner satisfactory to the public, as well as to the electrical companies.

The East River Electric Light company, which operates and controls the Thomson-Houston systems in New York city, emphatically denies the report that it has consolidated with any electric lighting company.

The Consolidated Gas & Electric Light company of Westchester county has been organized by Charles B. Ludwig, Brooklyn; Harold S. James and Arthur B. Elbecke, New York; Hanford M. Henderson, Port Chester, and Leonard G. Levy, Newark, N. J. The operations of the company will be carried on in the towns of Rye, Mamaroneck, New Rochelle, Harrison, and Scarsdale.

The gas problem is interesting several cities, and the defective system of mains in New York keeps the subject constantly before the people of this city. Last Monday John Fitzgibbons, while working in a subway at the corner of Fifteenth street and Third avenue, was overcome by gas and removed to Bellevue hospital. The poor construction of the gas mains has been a serious hindrance to the electrical subway, and is still a threatening danger.

W. H. T.

Boston, Mass.

BOSTON, Jan. 31.—Legislation upon matters pertaining to the distribution and use of electricity for light, power and other purposes, seems to be quite popular with the Massachusetts legislature now in session on Beacon Hill. Among the petitions received in the last two or three days are the following: From Mayor Hart of Boston, for a transfer of the authority now exercised by the board of gas and electric light commissioners over electric wires in this city to the city authorities; from Homer Rogers, chairman of the board of aldermen for 1889, that the board of aldermen be granted full control of all appliances used for the transmission of electricity in Boston; and from the Edison Illuminating company of Boston, for leave to increase its capitalization to $2,000,000. Among the orders adopted were the following: For preventing the state board of gas and electric light commissioners from granting franchises after such have been refused by the proper city or town authorities; for amending the public statutes so as to provide for the use of electricity as a motive power by street railways; for allowing cities or towns in granting any franchise to a telephone company, to exact gratuitous services from that company; for granting cities and towns the full control of poles and overhead wires used for the transmission of electricity for any purpose; for the establishment of a state board of electrical control, and finally for repealing the act of the year 1885, establishing the state board of gas and electric light commissioners. It is quite evident that the ideas of our legislators as to the most desirable method for controlling electric wires are somewhat mixed. We may next look for the appointment of an "electrical instruction committee" which will, like the similar committee of the New York senate, keep the legislators posted in the mysteries of electrical science.

Several petitions for elevated road charters have been received in the senate besides the West End and the Meigs' petitions. They have all been laid on the table in the house, and it is now hinted that the West End company would be very glad of a chance to prevent, through technicality in the rules, any of the petitions from being acted upon at this session of the legislature. It would be perfectly willing to have its own petition fail if all the others were to receive a similar fate, as it much prefers to develop its present electric system. The elevated road scheme was taken up largely for self-defense.

At the meeting of the city council last night an order was passed directing the president of the common council to petition the legislature at its present session in behalf of the common council for such legislation in regard to running surface cars in the streets of Boston as will enable the city council to establish a maximum speed for electric cars. An order was also passed requesting the committee on ordinances to report an ordinance "restricting any street railway company from running any street car at a greater rate of speed than seven miles per hour in any public street within the limits of the city proper." The councilmen are in favor of "rapid (?) transit" at seven miles an hour.

The matter of the city's electric lighting contract is still unsettled and uncertain. When the petition of the Suburban Light & Power company to erect poles in Roxbury and Dorchester came up before the aldermen this week, they refused to grant the right until a public hearing had been given. The time set for this hearing is next Monday at 2 P. M. A lively time is expected and it is thought by some that the hearing may last two or three days. George Westinghouse, Jr., is still in the city looking after the interests of the Suburban company, which will use his system of lighting. The Suburban company has been awarded the contract for the city lighting and now awaits the aldermen's permission to carry out its contract. This is, in brief, the situation at present. It is more than likely that the aldermen will visit Chicago to study the working of the underground wires in that city.

A public hearing was held in Chelsea last Monday before the state gas and electric light commissioners on the petition of twenty residents to compel the Chelsea Gas Light company to furnish incandescent lights to its customers by meter. The company claimed that it knew of no meter accurate enough for practical use.

On Thursday afternoon of this week the New England Phonograph company gave an exhibition of the working of the perfected phonograph and graphophone to representatives of the Boston daily papers. The North American Phonograph company is offering for sale here 20,000 shares of its capital stock at $75 a share, par being $100. Subscriptions will be received from Wednesday, Feb 5, at 10 A. M. till Saturday, Feb 8, at 12 o'clock noon.

O. H. M.

Burlington, Ia.

BURLINGTON, Ia., Jan. 31.—Electric street railways in Burlington may be considered an assured fact. The city council has considered an ordinance mutually agreed upon by the judiciary committee of the council and the railway officials. The ordinance passed its first and second readings, and will without doubt be finally adopted at the next regular meeting of the council. By the terms of the ordinance the company is granted the exclusive franchise for thirty years to operate an electric railway on the streets now occupied by it, and for two blocks on either side of its present lines, and is given the preference in any extensions that may be decided upon in the future. Work is to begin not later than April 1, and cars must be running by Nov. 1 next.

Judge Phelps in the District Court yesterday rendered his decision in the suit of the Burlington Electric Light & Power company against the Burlington Gas Light company for an injunction, and to have the lines of the latter company declared a nuisance and to have their removal decreed. The judge denied all the prayers of the plaintiff. The injunction is denied on the ground that the gas company owned an electric light plant and could use it for the public without securing a franchise, and therefore the recent act of the legislature which requires a franchise to be submitted to a vote of the people, did not apply. In regard to declaring the lines a nuisance the court holds that the defendant, having been granted the use of the street by the city, has not committed a wrong in erecting its lines thereon. As to the allegations that the defendant is destroying plaintiff's business, the court holds that if such is the case it can only be through competition, of which a court can not take cognizance, and as to any actual damage done to plaintiff's property by defendant, the proper remedy is a suit in court of law to recover.

O.

San Francisco, Cal.

SAN FRANCISCO, Jan. 20.—The granting of the electric light franchise to persons in Sacramento is causing a considerable stir. The franchise is quite a bonanza to those to whom it was granted. It runs for 50 years, and permits the use of any alley or street necessary, without restrictions. The franchise was passed at the last meeting with an amendment that $60,000 be spent on the plant in two years. The Capitol Gas company has been trying to get an injunction restraining the owners of the franchise from proceeding with the work.

W. G. C.

THE ELECTRIC LIGHT.

The Angola Schuyler Electric Light company of Angola, Ind., started its plant on January 20th.

Mt. Sterling, Ky., will be lighted by electricity. The Thomson-Houston company has been awarded the contract.

The Burlington, Ia., Electric Light & Power company is doubling its present capacity, making the plant five times the orginal size.

The Ball Engine company has just installed a steam plant at Somerset, Ky., for the Central Thomson-Houston Electric company of Cincinnati, Ohio.

The Chicago Edison company is wiring the new thirteen story building of C. C. Heisen on Dearborn street, Chicago, for 500 lights. Current will be furnished from the central station on Adams street.

The New Cumberland, W. Va., Electric Light, Heat & Power company, has received a contract for lighting the city and will immediately install an arc plant. The present incandescent plant will be enlarged.

Two new central stations are now being installed with the Westinghouse alternating current system, the one at Uxbridge, Mass., and the other at Gouverneur, N. Y. Each plant will have a capacity of 750 lights.

The Westinghouse Electric company has shipped a 125 light arc dynamo, Westinghouse new arc light system, to New York city. The machine will run in connection with converters, and the flat carbon lamp will be used.

The Carnegie library building in Allegheny City, Pa., is to be lighted by the Westinghouse alternating current system. This is the edifice which was erected by Mr. Carnegie, and presented to the citizens of Allegheny. The structure is composed of granite, and its arrangements are very handsome throughout. The total cost was about half a million dollars. A plant of 900 incandescent lamps will be operated in the building.

The increase of two 600 light machines in the plant of the Pennsylvania railway company, Fourth avenue plant in Philadelphia, is being made by the United States Electric Lighting company of New York. These machines will light the building, the storage batteries having been removed to another part of the building to make room for a Corliss engine and two United States dynamos. There has been no change in the wiring, switches, etc.

The annual meeting of the Norwalk & South Norwalk Electric Light company was held at Norwalk, Conn., January 13th. The year's business showed a most encouraging increase. The station has been very materially enlarged; a new 90-horse Ball engine with boilers has been installed; 1,300 Thomson-Houston incandescent alternating current lamps have been added, together with a 50-light Schuyler arc dynamo. The plant was put in by the Schuyler company in 1886, and since the day of starting has paid regularly a quarterly dividend of 2%. At the stockholders' meeting, the following directors were chosen: Hon Chas. Olmstead, Hon. G. R. Cowles and John H. Hoyt of Norwalk, Chas. E. Dustin of Hartford and Edward T. Jackson of Middletown. The officers for the year are: Hon. Chas. Olmstead of Norwalk, president; Hon. G. R. Cowles, Norwalk, vice-president; Chas. E. Dustin, treasurer, and John H. Hoyt, Norwalk, secretary.

St. Louis has a physician who claims to have given much time and attention to the study of the effect of electric light on the eye and he pronounces it injurious. His Chicago brethren pronounce him a crank, and flatly deny the statement. Among these is Dr. James M. Lydston, who said: "I consider the electric the best artificial light we have. It should be of the best manufacture and should be moderately used. But then the same is true of every other light. There are flickering electric lights, to be sure, and they should not be used by persons reading, working, or writing. But a steady incandescent electric light is the best obtainable. I have just seen a case of weak eyes—a young

man who works at night under an electric light. He thought the light was injuring his sight, entertainiog the same idea as the St. Louis doctor, evidently. But I found that there was a refractive error in his eyes which would have been affected by any other light in the same way. By this I mean that the lenses of his eyes were so constructed that to use them involved a painful effort. He was 'far-sighted.' I corrected this by the use of a pair of glasses. The electric light had nothing to do with it. No, I have never heard of any special optical disease resulting from the new light and am quite sure there cannot be any, because, as I have said, the electric light is a pure white light, 'softer' and more agreeable to the eye than a lamp or gas."

Electric lighting has made considerable progress on the Pacific coast and the outlook in that field is certainly bright. According to the *Pacific Electrician* in 1878 the electric light made its appearance in San Francisco, and was exhibited at the Palace Hotel; but it was not till 1879 that it came into practical operation. On June 30th of that year the California Electric Light company was incorporated, and immediately thereafter commenced furnishing Brush arc lights from the central station built in the rear of where the Flood building now stands. This was the first station erected for the distribution of lights from a common center. These works were entirely destroyed by fire on April 24, 1880. The company immediately erected a new station at 117 O'Farrell street. In less than two years the business grew beyond its capacity, and new works were erected on Jessie street. These were greatly enlarged in 1885, and in less than three years were found inadequate. A new building has since been constructed on Townsend street near Third. Nearly $1,000,000 is invested in the plant; and the number of arcs furnished in this city is nearly 2,000. Arrangements are now being made to introduce incandescent lights to the number of 10,000, by means of the alternating apparatus. This company has not confined its business to San Francisco, but, through individuals and "sub companies," has established electric lighting plants in seventeen other cities and towns, besides erecting some fifty private plants. The company is also engaged in the business of the distribution of electric power, and in establishing power plants. Starting with one small sewing machine electric motor in 1887, the business has increased, till it has assumed very large proportions.

THE ELECTRIC MOTOR.

Jackson, Tenn., wants an electric power plant.

The Card Electric Motor & Dynamo company of Covington, Ky., has been incorporated by Robert J. Smith, Alexander Montgomery, Alfred Mack and T. F. Corry for the manufacture of electric motors, dynamos, regulators, etc. The authorized capital stock is $200,000.

Cleveland, O., capitalists announce a project for the extension of the Collamer branch of the East Cleveland Railroad through the villages of Wickliffe, Willoughby, Mentor, Painesville, Perry, Madison, Unionville, Geneva, Saybrook and Ashtabula. It is claimed that a single track with the necessary switches can be put down cheaply, that wooden poles will do for wire supporters, and that a line operating on thirty minutes' time from car to car will pay. It is quite probable that the Collamer line will be extended ten or fifteen miles during the present year. The construction of this line to East Cleveland served to boom residence property in that locality.

A correspondent at Rochester, N. Y., writes that the proposal of the street car company to operate its lines by electricity is favorably received and that a committee from the common council, which is arranging details, has had a conference with the officers of the company Continuing he says: "It is expected that there will be electric cars running here in April. The intention of the company is to run the Charlotte cars up town first. The Lake Shore road from Charlotte to Manitou Beach is a fixed fact and there is also some talk of an electric road from Webster and Sodus via the Glen Haven route to connect with the Northern Central railroad. The light and motor business of the several electric companies is booming and all are busy. The seven story building, "Forsyth's," on Spring street for families will be lighted throughout by the Edison company, and the elevators will be run by motors The large elevator in the American Express building is run successfully by a Brush arc motor."

The marvelous and substantial development of the electric systems and the fact that wherever they have been properly built they have almost entirely conquered the unreasonable prejudice and opposition which confronted them is a matter for congratulation, says the *Street Railway Journal*. Notwithstanding the victories they have gained, however, it seems necessary to fight the same battles over and over again in nearly every city in which application is made to install an electric plant. The old absurd objections have to be met over and over again; the element of danger to human life, the fear that the poles and wires will disfigure the streets, that horses will be frightened and others equally groundless, are among the list. It is not denied that there are some things about electric traction that its advocates wish were different. Thus far the business has been in an experimental state; but it must be admitted that railroad and electric men have been doing the very best they know how to get out of this state into that of assured success. It is now so near that we marvel that it has been done so quickly. It is safe to say that the abuse now hurled against electric traction is prompted by greed or malice, or done through ignorance. Hereafter any city council that opposes an application to build electric roads, on any of the old grounds, exposes its own ignorance and lays itself open to the suspicion that it is waiting to "see something" or that it is unwilling to profit by the experience of others. We have seen what electric traction has done in the face of strong opposition; it has now earned the right to have fair play and we say stop now and lend a helping hand, and at the end of the next five years the world will wonder that it ever needed an article in its defense.

The development of the electric motor has progressed rapidly within the past few years, until little seems to be left for future accomplishment in the way of efficiency, regulation and reliability, says *Power-Steam*. Notwithstanding the fact that this system of power distribution has attained to such perfection, the development of the field for its application has just begun. To one who is inclined to be speculative upon this subject, the future opens up an attractive vista of application of this convenient, ever-ready and portable force to lightening the labor of existence, and enhancing the conveniences and comforts of life, which is truly marvelous. What numberless little operations now performed by hand will be delegated to the electric motor; what modifications of the shop and factory system will come with power in every man's home, and what conveniences, now unthought of, will be accomplished as a matter of course, with power to spare, and accepted by following generations as matters not to be dispensed with, can better be imagined than specified.

The midwinter is not generally considered by street railway construction companies the most active and busy time of the year. The conditions of soil and weather are unfavorable for outside work, and the amount of business to be performed by the street railway companies is not so great as in the summer months, and does not encourage extensions. The Sprague Electric Railway & Motor company, however, announces that during the last few months an unusually large number of contracts has been closed for electrical apparatus, and that construction work will go on right through the winter. A list of the roads which have ordered equipments from this company illustrates in a striking way the remarkable confidence which street railway managers feel in the electric system, and is indicative of a widespread adoption throughout the country by street railway companies, of electrical apparatus. Among the most recent contracts of the Sprague company may be mentioned the following: Salem, Ohio, Capital City Street railway, two cars; Davenport, Ia., Electric Street Railway company, four cars; Dubuque, Ia., Electric Street railway, four cars; Dubuque, Ia., Electric Light & Power company, ten cars; Chicago, Ill. Cicero & Proviso Street railway, twelve cars; and the following orders from railway companies already equipped by Sprague or other systems: Sioux City, Ia., Electric railway, three cars; Milwaukee, Wis., West Side Street railway, nine cars; Des Moines, Ia., Electric railway, two cars.

The Wisconsin Telephone company recently applied for an injunction against the Eau Claire Street Railway company restraining the latter from operating its electric line. In dismissing the petition Judge Bundy says the telephone company has violated the law which it had the legislature enact. This law provides that any persons transmitting electrical energy must insulate or put in return wires to prevent damage to persons and property, and that persons injured by neglect of the act shall be granted a preliminary injunction The judge said the telephone company was largely responsible for the trouble, to remedy which an injunction was asked; that it should put in return wires instead of using the earth and then sue to recover the cost if caused by wrongful acts of the defendants; that this single trolley system of street railway, by which the electricity returns through the track, is of reasonable perfection and defendant can not be required to put in the double trolley system, and that an injunction would practically destroy defendant's property, which the court was not prepared to do. Another case of this kind was recently passed upon by Judge Lane of the Third judicial district court of Utah, when the case of the Rocky Mountain Bell Telephone company against the Salt Lake City Street railway company was tried. The plaintiff sought to enjoin the defendant from operating its lines parallel with the telephone wires. The evidence put in by the telephone company was to the effect that the service was so greatly impaired by the interference from the single trolley system used by the railway company as to be, in the case of many subscribers, practically useless, and the defence of the railway company was that the double trolley system was impracticable on their routes, and that the adoption by the plaintiff of the "McCluer system," or, at any rate, of a metallic circuit system, would be a complete remedy for the evils complained of. The decision of the judge denied the prayer of the complainant for an injunction. It concludes as follows: "Assuming that the use of the metallic circuit would remedy the evil complained of, and that its use is equally practicable by either party to this action, the court will not enjoin the use of the ground circuit by the defendant while the plaintiff continues to use it. It appears from the preponderance of evidence that the use of the metalic circuit by the plaintiff is practicable; while its adoption by the defendant would be an experiment, its practicability does not appear to be established. The prayer of the complainant for an injunction is denied."

THE TELEGRAPH.

South American dispatches announce that a defalcation of 90,000 pesos has been discovered at Rio Janeiro, in the Telegraph Department, of which Baron De Capanema was chief. The baron had been arrested and lodged in prison. It is asserted by the cashier of the department that De Capanema disposed of the money, and that he was assisted by others, against whom warrants of arrest have been issued.

The cable announces that the Chefoo Telegraph Convention has at last been ratified by the Tsung Li Yamen. It is an agreement between the Chinese Telegraph Administration and the Eastern Extension and Northern Telegraph companies to act in concert in the matter of telegraphic rates to the far East. A uniform rate of $2 per word from all parts of China to Europe will be charged. The agreement is to run for fourteen years from the time it was drawn up two years ago.

The action of the Great Northwestern Telegraph company against the Montreal company was dismissed at Montreal January 31st. When the telegraph amalgamation took place in Canada some years ago the Great Northwestern Telegraph company in leasing the Montreal Telegraph company, agreed to pay it a rental of 8 per cent. on its capital. Recently, through competition and the Montreal company giving the Canadian Pacific Telegraph company privileges which decreased the value of its property to the Great Northwestern, the latter has found it impossible to earn with the Montreal plant the rent demanded for it, and recently entered an action against the Montreal company for $80,000 damages for the trespasses of the Canadian Pacific company, and to secure a reduction of the rent. The court held that the action should have been begun against the Canadian Pacific.

Carelessness on the part of employes frequently involves the telegraph companies in litigation. In Findlay, O., a suit has just been begun for $5 000 against the Western Union Telegraph company by John Allen. Allen in his petition alleged that he sent a telegram to his wife at Groveland, N. Y., March 12, 1889, telling her to leave for Findlay the 14th, that he would be at Fremont to meet her He charges that the operator changed the message to read "to-morrow," which was the 13th. When Mrs. Allen arrived at Fremont she could not find her husband. She then came to Findlay alone, arriving there at midnight. She made inquiries regarding the whereabouts of her husband, but could find no one who knew him. Being unacquainted with the city she remained at the station until morning. She was so badly frightened over the affair that she took to her bed where she remained several weeks. The petition states that she never recovered her health.

THE TELEPHONE.

At the meeting of the Chicago city council last Monday a resolution was adopted instructing the mayor and controller to direct the Chicago Telephone company to replace the instruments removed from the police stations and public offices.

The officers of the Nebraska Telephone company entertained Prof. Alexander Graham Bell at Omaha, Neb., on his recent visit to that city. A banquet was served at the Union club and many distinguished guests were present. Gov. Thayer and Mayor Cushing were among the speakers and Prof. Bell made a fitting address.

Personal Mention.

David Chalmers of the Empire City Electric company of New York, was in Chicago last week.

Dr. Werner Von Siemens of Siemens & Halske, Berlin, has retired from active business and hereafter will devote his entire time to scientific pursuits.

Business Mention.

Henry A. Rogers of New York city, reports a large trade in electrical supplies.

The Butler Hard Rubber company report an increasing business in their hard rubber jars for primary and storage batteries under Kiel's patents.

The Williams Engine company of Beloit, Wis., has recently sold two engines of 500-horse power capacity each, to the Detroit Electric Light & Power company.

Jas. W. Queen & Company of Philadelphia, will have a large display of their electrical goods at the Kansas City convention of the National Electric Light association.

The Okonite company of New York, reports large sales of cables and insulated wires. The new building of the company will give it facilities which will enable it greatly to increase its capacity.

James F. Kelly, general sales agent for the Edison-Lalande Battery company, reports an unusual business so far. The company has had orders and shipped over 1,000 cells during the last few weeks.

The Fishkill Landing Machine company of Fishkill-on-the-Hudson, N. Y., is finding that its Fishkill-Corliss engine is growing in popularity with electric light companies throughout the country. The engine is economical, efficient and durable.

The Abendroth & Root Manufacturing company of 28 Cliff street, New York, are receiving large orders for their sectional steam boiler. The company recently issued a new catalogue containing information of value to all persons interested in steam plants.

R. T. White of 12 Pearl street, Boston, reports large orders for his patented material for street railway road beds, including the well-known "Daisy" chair. Mr. White is meeting with gratifying success in the introduction of his devices, which, it is understood, are satisfactory to users in all cases.

The National Pipe Bending company of New Haven, Conn., has just issued a little pamphlet descriptive of its feed water heater. The little book contains a partial list of firms and companies in the United States and foreign countries using the heater. As the list occupies twenty-eight finely printed pages it may be seen that the heaters have had an extensive sale. It is a splendid showing.

Messrs. Lyle & Lee of Dowagiac, Mich., have just started their electric plant. The Ball Engine company of Erie, Pa., furnished the engine. The Waterhouse Electric company of Baltimore, Md., has just installed its fourth 100 horse power Ball engine. Messrs. Chas. R. Vincent & Co., 15 Cortlandt street, New York City, agents of the Ball Engine company, have just delivered a thirty-five horse

power engine to the Brooklyn Navy Yard for the new electric light installation.

The Eclipse Wind Engine company of Beloit, Wis., has recently received large orders for rope sheaves, friction clutch pulleys, cut-off couplings, shafting, stands, etc. A great number of electric light and power companies have recently sent in orders. The company is obliged to run its factory day and night.

L. Rosentamm of Lewisohn Bros., New York, will represent the firm at the Kansas City Electric Light convention. Their very ingenious circular calendar will be cheerfully mailed to any in the trade, and should be appreciated by the possessor for its artistic beauty. They report exceedingly large sales and double working hours to keep up with orders.

The Cincinnati, O., Electric Engine company's latest catalogue illustrating its electric motors, contains much valuable information on the transmission of power and the relative merits of the several systems. The catalogue is handsomely illustrated and contains a good description of the machines which the company is placing on the market as well as numerous complimentary letters from those who have used them.

The Concord, N. H., Horse Railroad company, which has adopted electricity as a motive power, has contracted with the Tripp Manufacturing company of Boston for antifrictional journal bearings which will be furnished with the truck complete. These bearings are giving perfect satisfaction on various roads, and they are rapidly coming into general use. The severe tests given them place their durability beyond the field of experimeot.

The Jewell Belting company of Hartford, Conn., recently received an order for 100 feet of 37-inch belt to replace a link belt which had been running about six months, but which had broken several times. This company is one of the oldest and most successful in the field, and has made a specialty of furnishing electric lightiog and power plants. It has been very successful in this respect. W. H. Salisbury & Co. represent the company in Chicago.

Since E. H. Johnson retired from the Sprague Electric Railway & Motor company he has found another interest awaiting his attention, which now promises to develop into considerable importance. Mr. Johnson reports that "the operation of the Interior Electrical Conduit company has been enlarging so rapidly and the application of its insulating processes has become so general and diverse as to render the present organization wholly inadequate. A new company has in consequence been organized and will not only acquire the stock and property of the Interior Electrical Conduit company, but as well certain new and valuable inventions in the same general line." The new company is called the Interior Conduit & Insulation company; capital $1,000,000. The incorporators are E. H. Johnson, E. T. Greenfield, Siegmund Bergmann, J. H. McClement and Philip H. Klein, Jr. It is anticipated that the operations of the company will excite interest among the electrical trade.

The new building at the works of the Westinghouse Electric company was completed a few days ago and the necessary machinery is now being installed. It will be ready for occupaocy by February 1st. This is the structure which has been put up in the place of the one burned in September last. The new factory is a six-story brick structure, 60x150 feet, and its space will greatly add to the capacity of the works. The ground floor is to be used for the storage of dynamos, exciters and motors. On the second floor will be a draughting room and the rear portion is to be set apart for the winding department for large converters. The third floor will be used entirely for the manufacture of converters, 100 winding lathes being put on this floor. On the fourth floor the manufacture of the flat carbon arc lamp will be carried on and five hundred lamps are to be the weekly capacity. The fifth floor is set apart for the same purpose of arc lamp manufacture, while the sixth floor will be used for storage. The new building will form an addition to the works which the company, on account of its constantly increasing business, has been greatly needing.

Jas. W. Queen & Co., the well-known makers and importers of electrical test instruments, report rapidly increasing and encouraging sales of their large resistance boxes. Among the recent purchasers of the high grade boxes, are the University of Cincinnati, New York Arsenal, and Lehigh University. The California Electric Light company writes in reference to a large set, Prof. Anthony's design, recently purchased: "The set is simply perfection." A megohm box of special pattern with all the metal portions mounted on corrugated pillars for most effective insulation, has just been introduced. Their magnetic vane instruments, which were recently described in these columns, are very satisfactory, and are now being put upon the market in large quantities. The Brush Electric company of New York purchased nineteen of these instruments for station work during the summer, and have recently bought six more for their new plant in Minneapolis. Queen & Co. report the sale during the past week of their large new standard Bunsen photometer to the Schaeffer Electric company of Boston. They have also gotten up a new form of portable photometer for street work.

The Metropolitan Electric Light company operates a number of large central stations in the city of London, Eng. One was recently equipped with an outfit of seven Westinghouse compound engines. Another station operated in the same city by the same company is equipped with single-acting engines of English make. Quite a good natured rivalry exists, of course, between the men who are in charge of these stations. Recently, the American engines were put through their paces by British experts, on behalf of the Metropolitan company, in a test lasting twelve hours without intermission. It was amusing to see the interest taken in this test by the American colony in London, many members of which spent the greater part of the day in the station. Even the American minister, Mr. Lincoln, was on hand to see the American eagle properly comforted and encouraged in its hour of trial. Being called away on important business, he returned at a later hour, in order to make sure that American interests and American dignity were being properly upheld. The engines in question are running regularly under a very heavy service, and the experts subjected them to many severe tests during the day; but they behaved so splendidly in all respects that the Englishmen were agreeably surprised. Some of the Americans who took such a lively interest in this test really know very little about steam engineering, but they were wildly enthusiastic at the way in which these engines upheld America's reputation for good machinery in London. Already orders have been sent to the Westinghouse Machine company at Pittsburgh for four more Westinghouse compound engines for the same London station, so that it is fair to assume that this type of engine is giving satisfaction. There are also rumors afloat that the other London station of the Metropolitan company, which is now equipped with English engines, will soon be supplied with Westinghouse compound engines from Pittsburgh.

Electrical Patents.

Issued Jan. 28, 1890.

420,057. Wind-Vane Indicator. Henry J. Haight, New York, N. Y.

420,070. Electric Detecting Apparatus for Coin Actuated Boxes. William J. Howey, New York, N. Y.

420,077. Incandescent Lamp Socket. Hermann Lemp, Hartford, Conn.

420,079. Electric Reciprocating Tool. Harry N. Marvin, Syracuse, N. Y.

420,080. Electric Reciprocating Tool. Harry N. Marvin, Syracuse, N. Y.

420,091. Testing Apparatus for Telephone Exchange Switches. Joseph J. O'Connell, Chicago, Ill.

The invention consists in the improvements in switch-boards whereby the spring-jacks are in large part replaced by plain switch-seats, while the test battery is removed from the circuit of the telephone outfit to that of the connecting plugs or switching appliances, and is so organized with the other parts as to prevent the false click signals and calls, which in the old relation of the test battery would follow the use of plain socket terminals.

The first claim reads:

"In testing apparatus for telephone exchanges, the combination, with the telephone line and its terminal, of the separate switch appliance therefor, a test-battery having a ground branch, and on its opposite side being connected up with said separate switch and through it to line when such line is closed by the switch for conversation, and the operator's receiver having independent switch connection with the telephone line."

420,096. Lightning Arrester. Charles A. Pfluger, Chicago, Ill.

420,101. Conduit for Electric Street Railways. Jesse W. Reno, Boston, Mass.

420,102. Telegraphic Transmission of Index Movements. Felix Richard, Paris, France.

The object of the invention is to provide a system for transmitting to a distance the indications furnished by an instrument comprising an index or needle movable over a dial, these indications on their transmission to the receiver being reproduced by the movements of an index or needle. For a recording instrument the index of the receiver moves with reference to a band of paper, which is moved under the action of a clock work. The tracing point of the needle traces on the moving band of paper a line, the successive ordinates of which indicate the successive positions of the needle of the transmitter.

Claim 10 reads as follows: 'In a system for telegraphically transmitting the indications of a movable index, the combination, as a receiving instrument, of two clock works, an index movable in one direction by one clock work and in the opposite direction by the other, a receiving electro-magnet or magnets adapted when operated to liberate the one or the other of said clock works, and two circuit-closers, operated upon the release of the respective clock works."

420,109. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill.

The invention relates to electric arc lamps in which a regulating magnet is attached rigidly to the frame of the lamp, and a suspended lifting magnet is employed.

The last claim follows:

"3. In an electric arc lamp, an electro-magnet in the shunt of the arc, a pivoted armature lever responding to the changes in the strength of said shunt-magnet, in combination with a magnet in the main circuit and a pivoted armature lever responding to the changes in strength of said main circuit magnet, a carbon rod, and clutch for the same, said clutch being carried and controlled by the said armature levers, whereby the movements of either armature lever may be communicated to the clutch to feed and regulate the lamp."

420,117. Electric Motor and Regulator Therefor. Elmer A. Sperry, Chicago, Ill.

420,138. Regulator for Dynamos. James J. Wood, Brooklyn, N. Y.

In this regulator the shifting mechanism is driven from the armature shaft through frictional gearing. The shifting mechanism may be used to effect any change by which the dynamo may be regulated or governed, and in this instance is used to shift the collecting brushes around the commutator.

The first claim is:

"The combination, with a dynamo regulator of the class wherein a shifting mechanism is connected in either direction to a source of power by the action of an electro-magnetic device, of a retarding device for resisting undue movements of the mechanism connected thereto through the medium of a frictional connection adapted to slip in the case of a quick and forcible movement."

420,171. Insulating Casing. John A. Seely, New York, N. Y.

420,173. Electric Fire Alarm System. John Speicher, Jersey City, N. J.

420,183. Telephone Exchange Apparatus. Franklin G. Beach, Chicago, Ill., and Frank B. Cook, Toledo, O.

420,198. Automatic Safety Cut-Off for Electric Circuits. George M. Guerrant, New York, N. Y.

The object of the invention is to short-circuit the electric current as soon as any rupture occurs in the main circuit, and bring into action mechanism that breaks the main circuit at the dynamo, thereby preventing injury to individuals or to other electric circuits, because the current is entirely cut off from the main line until the break can be repaired, and the current again sent over the external circuit.

420,214. Electric Meter. Walter F. Smith, Philadelphia, Pa.

420,217. Ocean Signal. Walter Thompson and Alfred Gartner, Newark, N. J.

The object of the invention is to enable the commander of a steamship or vessel to ascertain the course or direction of an approaching ship in a fog or under such circumstances that the approaching vessel cannot be seen, thereby avoiding danger of collision at sea.

The third claim reads: "In an electric ocean danger-signal or metallic revolving drum, an arm connected with said drum, a diaphragm connected to said arm, a metallic brush secured to said diaphragm, a funnel secured to said arm, and means for revolving said drum."

420,234. Plate for Secondary Batteries. George A. Johnson, Boston, Mass.

420,240. Printing Telegraph. James F. McLaughlin, Philadelphia, Pa.

420,255. Electric Signal. John D. Taylor, Piketon, Ohio.

420,300. Therapeutic Magnet. Thomas H. Hicks, Detroit, Mich.

420,314. Electric Arc Lamp. Rupert Schefbauer, New York, N. Y.

420,334. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

420,351. Advertising Automaton for Store-Windows. George Music, Berlin, Germany.

420,358. Printing Instrument or Apparatus for Telegraphic or Other Uses. James H. Rogers, Bladensburg, Md.

The feature which mainly characterizes the invention is that the letters or figures to be produced are formed by a system of rods or levers, the acting ends of which are brought closely together, so that the mark made by one may join or nearly join the mark made by another, and which at these ends carry each its appropriate element, by the conjoint use of two or more of which the representation or approximate representation of the desired letter or figure can be impressed or marked upon a strip of paper or other receiving material.

420,370. Incandescent Lamp Socket. Merle J. Wightman, Lynn, Mass.

420,384. Electrical Communicating System. Alfred G. Holcombe, New York, N. Y.

420,391. Gas-Pipe Insulating Device. Edwin W. Rice, Jr., Lynn, Mass.

420,393. Telegraph Apparatus. Ebenezer B. Shafer, New York, N. Y.

420,396. Electric Transformer. Elihu Thomson, Lynn, Mass.

The claim is appended:

"A transformer or reactive coil for circuits carrying alternating or otherwise varying current, having a core consisting of a laminated structure made up from sheet-iron plates coated with an electric insulator, and plates of zinc or other non-magnetic metal interposed at any desired intervals, all being bound together as a solid core structure."

420,398. Governor for Dynamos or Motors. Addison G. Waterhouse, Hartford, Conn.

The claim reads as follows:

"The combination in a dynamo electric machine, of main and derived circuit coils applied to separate legs of the field magnet, and an armature rotating in the magnetic field in a plane such that a shift of the consequent magnetism by variations of exciting current will cause the field magnetism to move transversely to the armature."

420,422. Current Direction Indicator. Ernest P. Warner, Chicago, Ill.

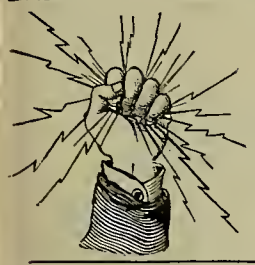
The invention consists in an electro-magnetic device having return poles on opposite sides of the central or main pole of the core, in combination with a permanent magnet having its polar extensions inclosing the end of the pole of the core, so that each polar extension will come between said core and one of its polar extensions, this permanent magnet being pivoted and adapted to vibrate in different directions, according to the direction of the current through the coil of the electro-magnet.

The invention also consists in a local circuit, containing a signaling device, said circuit being adapted to be closed by the movement of the permanent magnet in a particular direction.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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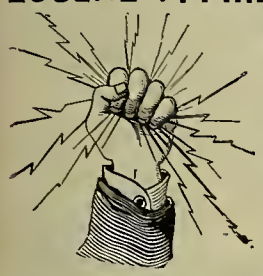

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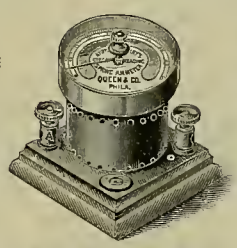

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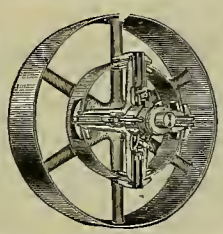

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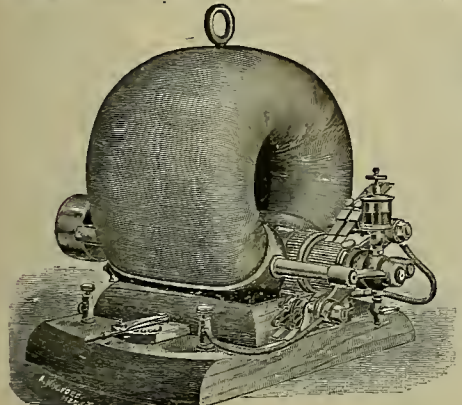

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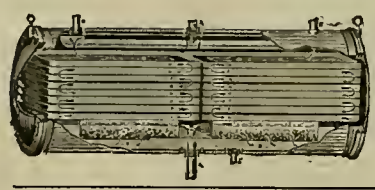

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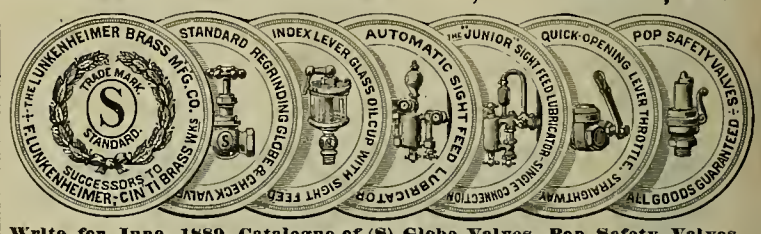

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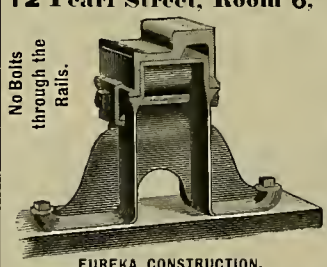

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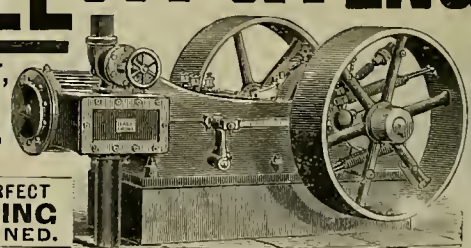

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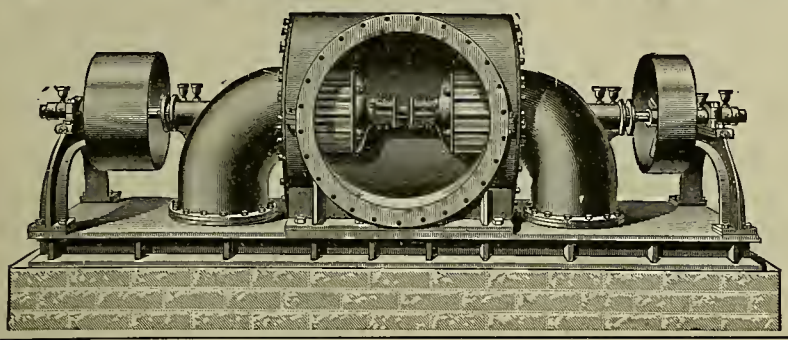

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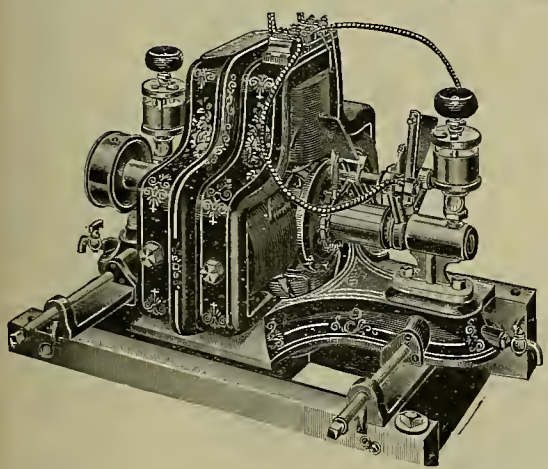

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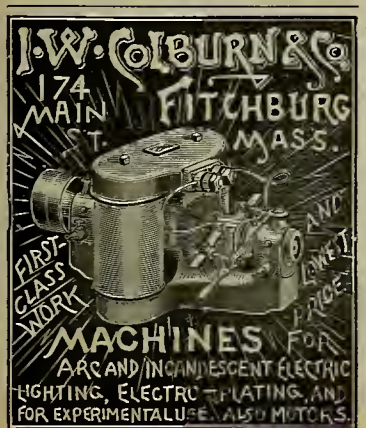

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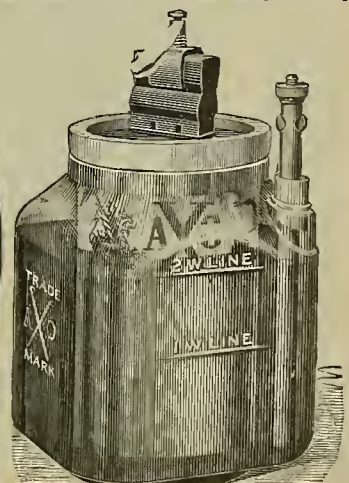

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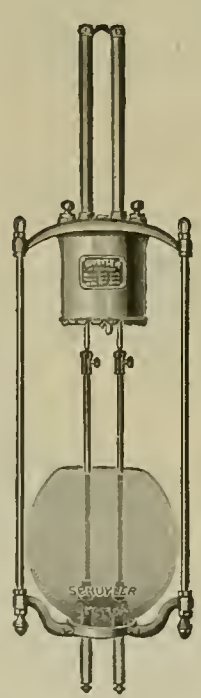

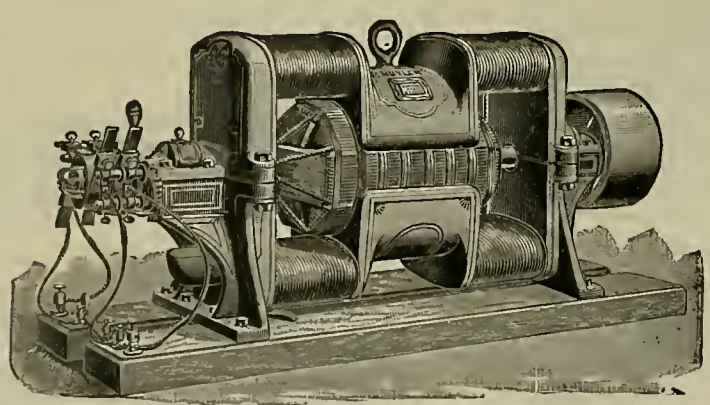

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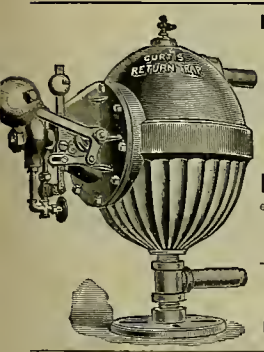

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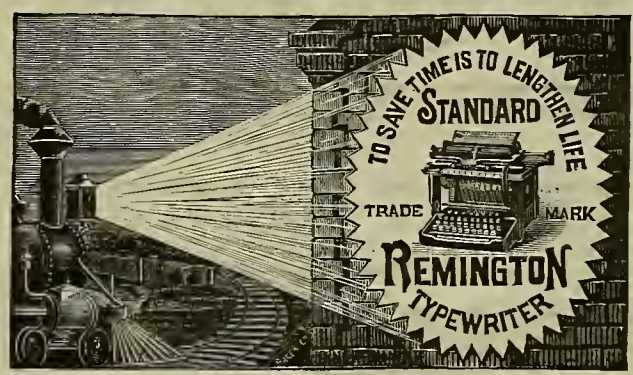

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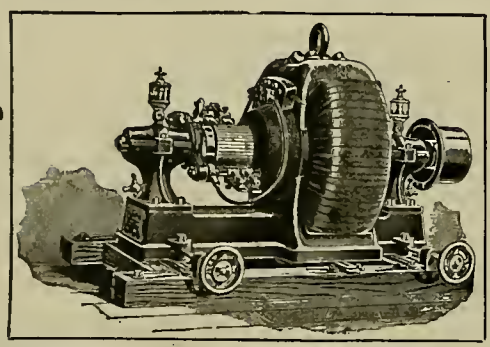

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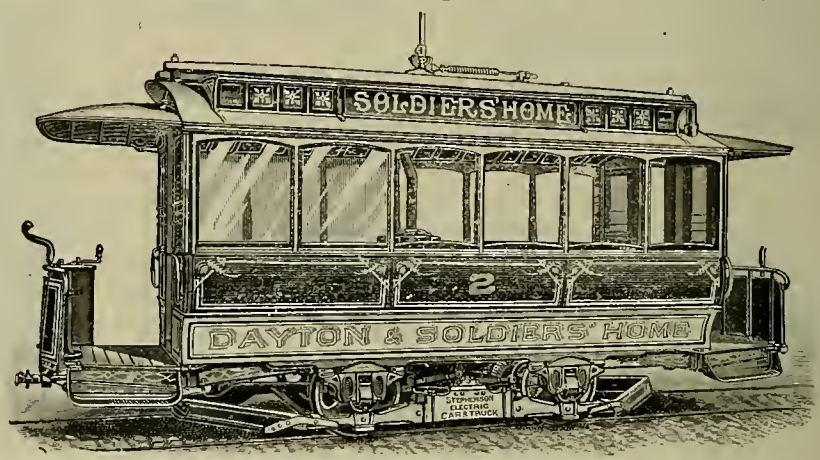

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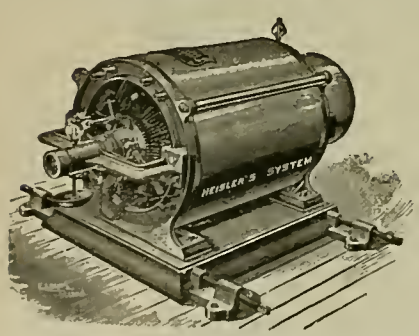

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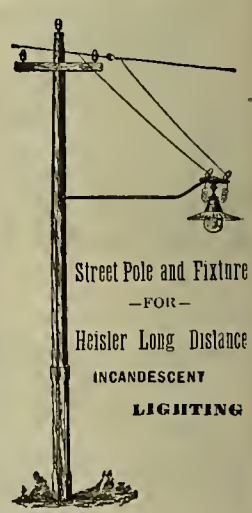

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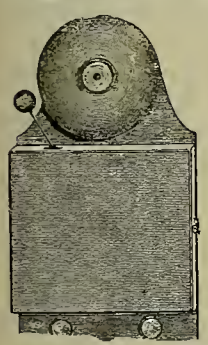

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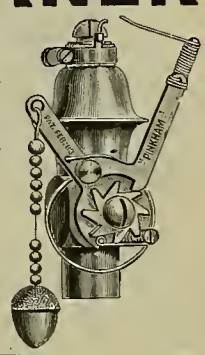

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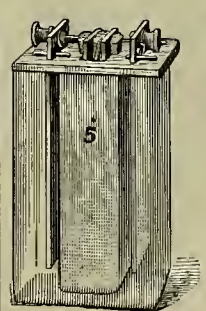

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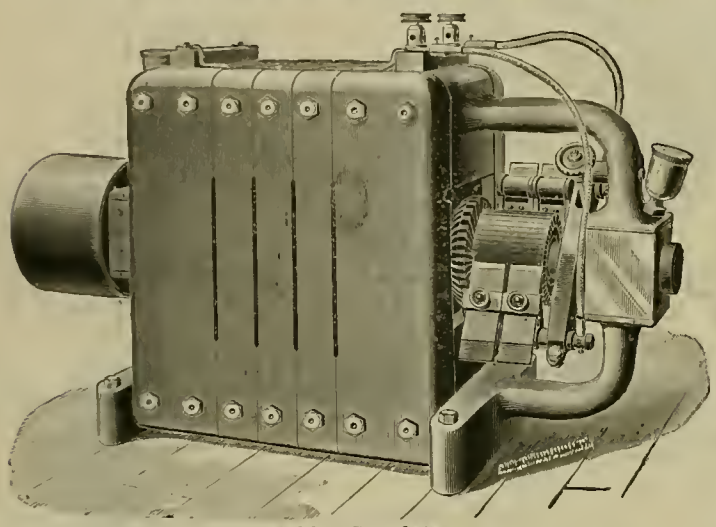

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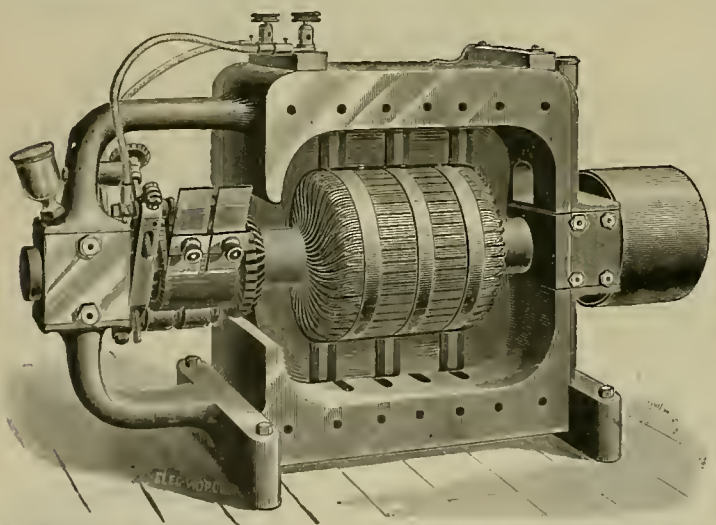

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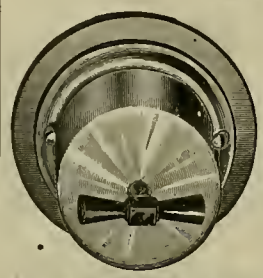

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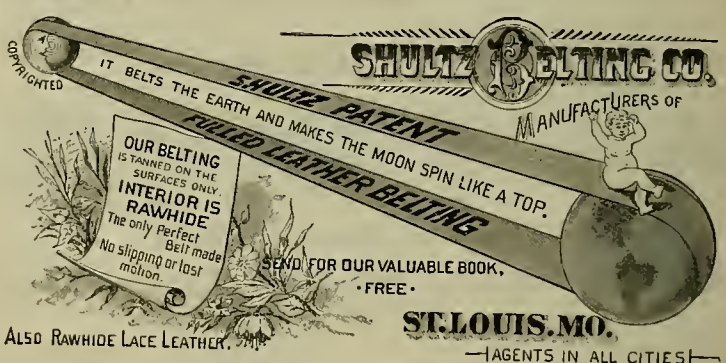

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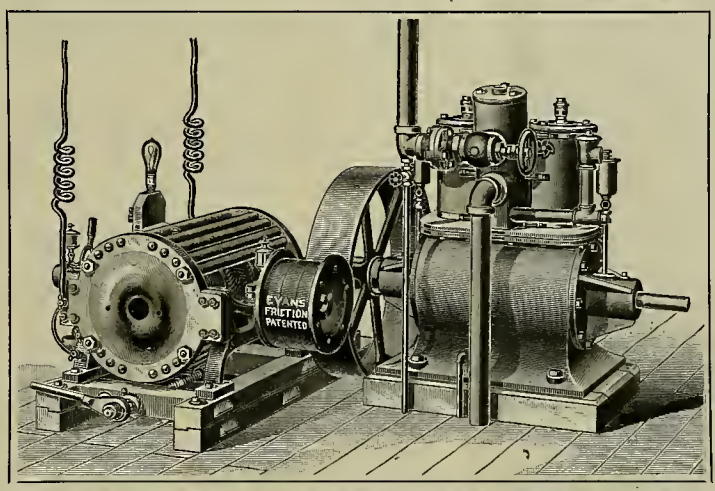

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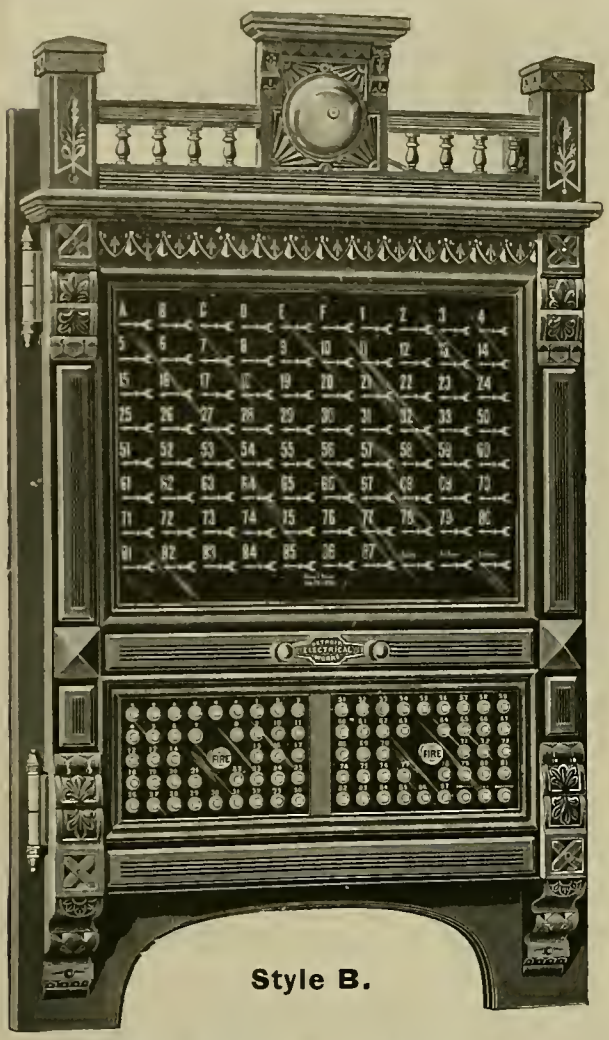

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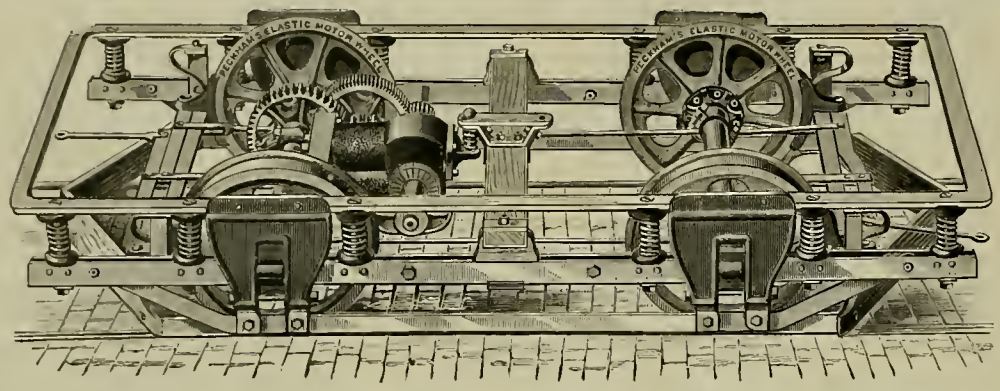

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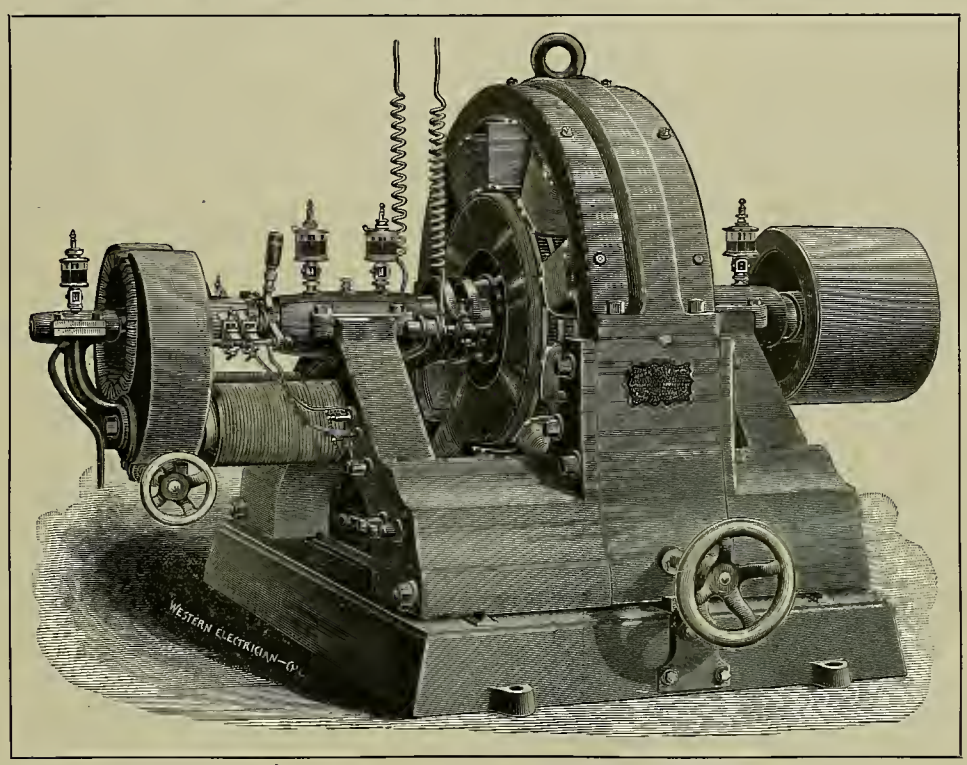

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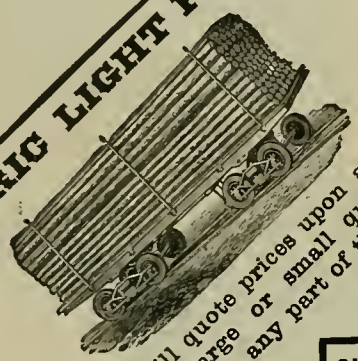

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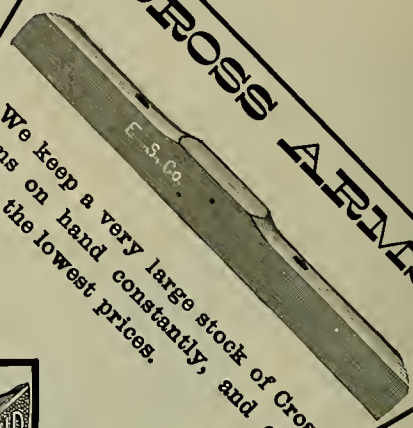

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A Line Wire of Very Superior Insulation.

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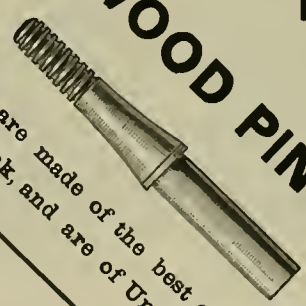

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IMPORTANT.

BRUSH PATENT SUSTAINED.

The broad right to the use of Double Carbon Electric Arc Lamps declared to belong to the Brush Electric Company, under U. S. Letters Patent to Charles F. Brush, No. 219,208.

In the suit of The Brush Electric Company vs. The Fort Wayne Electric Light Company, decided at Indianapolis, Dec. 24, 1889,

JUDGE GRESHAM HOLDS:

1. *That Brush was the Pioneer Inventor in Commercial Arc Lighting.*
2. *That the Brush Patent in suit is the Pioneer Patent for Double Carbon Arc Lamps.*
3. *That the Patent is Broad and Fundamental.*
4. *That all its Claims (six in number) are valid.*
5. *That the claims of the Patent are all infringed by the Defendant.*

The Court says: "The separation of the two pair of Carbons, so that the Arc is established between one pair and maintained between the Carbons of that pair until they have been consumed and then automatically established between the Carbons of the other pair and maintained between them until they have been consumed, is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the Lamp in suit from all prior lamps."

The Brush Electric Company is assured by the most competent legal advisers that under this Brush Patent, as interpreted by the U. S. Circuit Court, practically all Double Carbon Electric Arc Lamps now offered for sale are

INFRINGEMENTS

and notice is hereby given that Infringers, whether manufacturers or users, will be prosecuted and held for damages to the full extent of the Law.

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INCANDESCENT LIGHTING,

—AND THE—

WOOD SYSTEM

—OF—

ARC LIGHTING.

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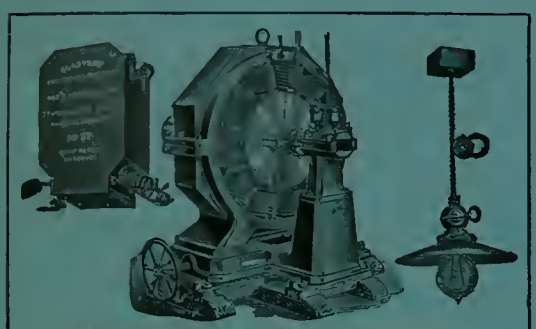

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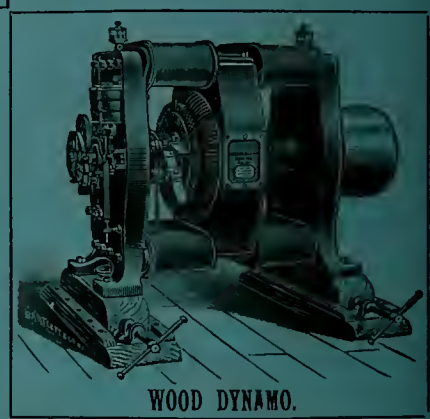

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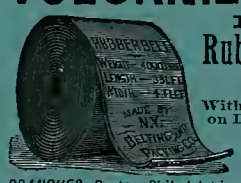

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FOR BARE AND INSULATED WIRE SEE PAGE XXVIII.

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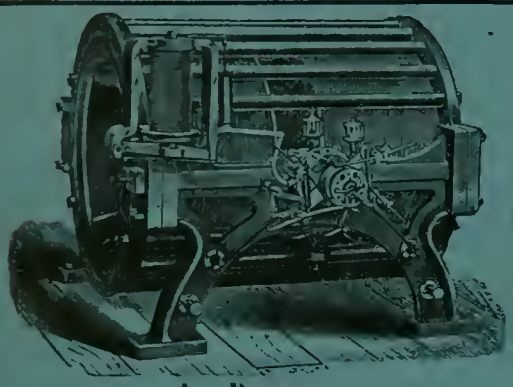

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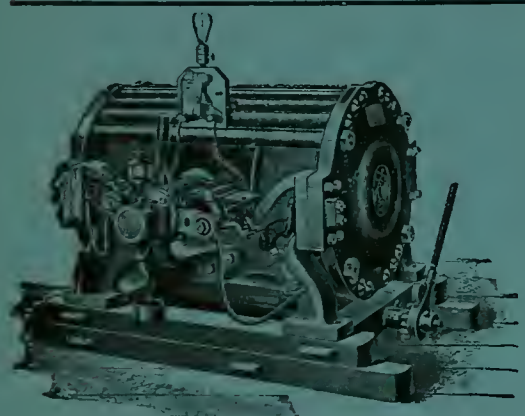
No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent., are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.



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Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.

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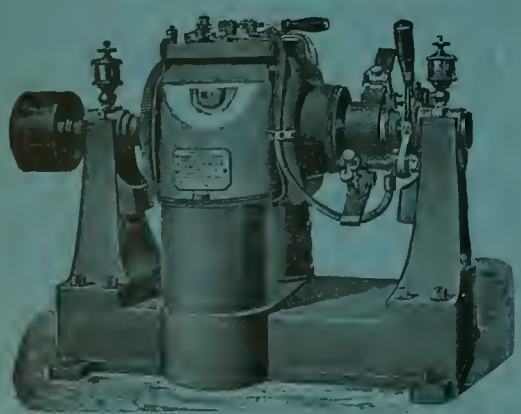
The problem of long distance incandescent lighting is practically solved by the alternating current dynamo, and to meet the demand for a machine of this character we have constructed what is unquestionably the most perfect alternator offered the public to-day, embracing as it does, all the features that combine to make a perfect dynamo—automatic regulation, perfect mechanical construction, highest efficiency, and economy of operation.



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The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

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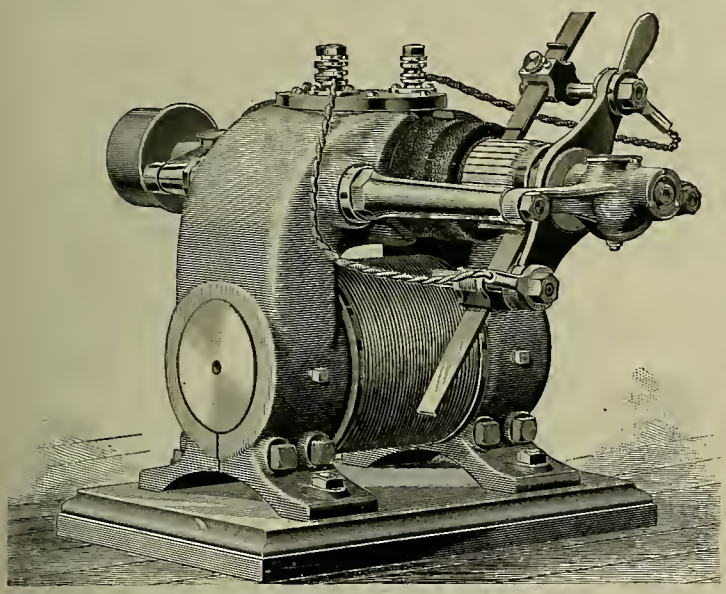

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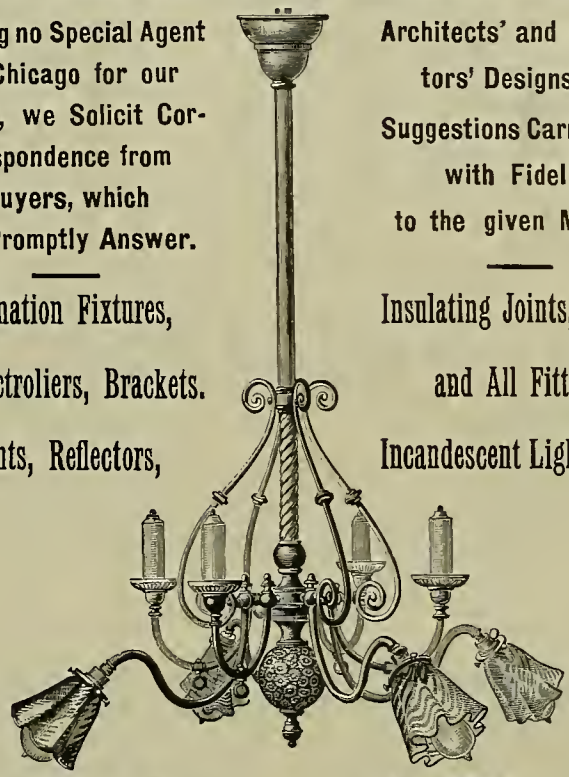

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Temperature	60° F.	60° F.	60° F.	60° F.	60° F.
Resistance	3,200	3,300	3,300	3,300	3,300

Time	30 min.	30 min.	30 min.	30 min.
Temperature	40° F.	115° F.	167° F.	200° F.
Resistance	3,900	162	12	5.2

The times given in the upper table are those between the immersion of the wire in water and the making of the test.

The times of the second table indicate the time between that at which the tank reached the indicated temperature and that at which the test was made.

The cable had been immersed in water for a month before the first temperature test was made.

It will be observed that the temperature being at 60° F. the resistance remained constant at its highest point for 24 days, and than raised greatly on lowering the temperature.

The lowering of resistance by a rise in the temperature is a common characteristic of all such insulations and indicates no defect. Most insulations are much more affected by this cause than was this one.

This wire also showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas. Very truly yours,

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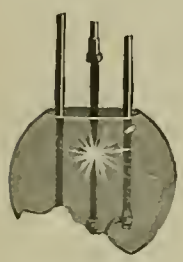
FOR INCANDESCENT CIRCUITS.



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IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

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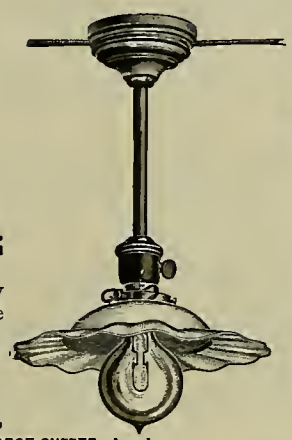
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



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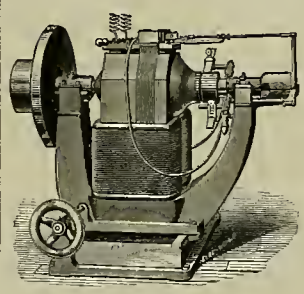

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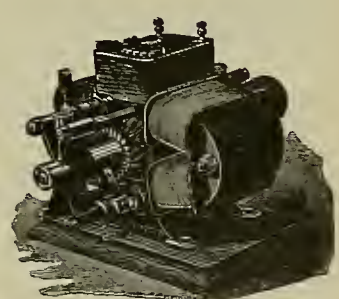

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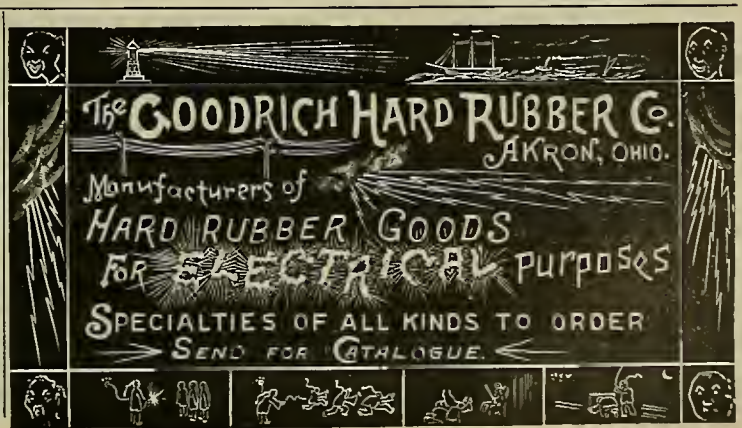

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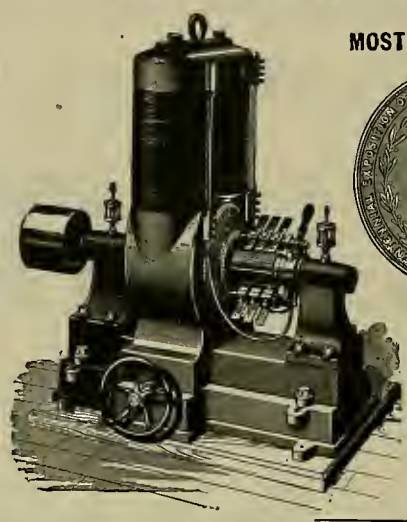

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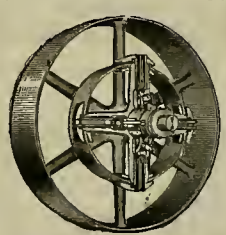

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They have a good record, running through five years.
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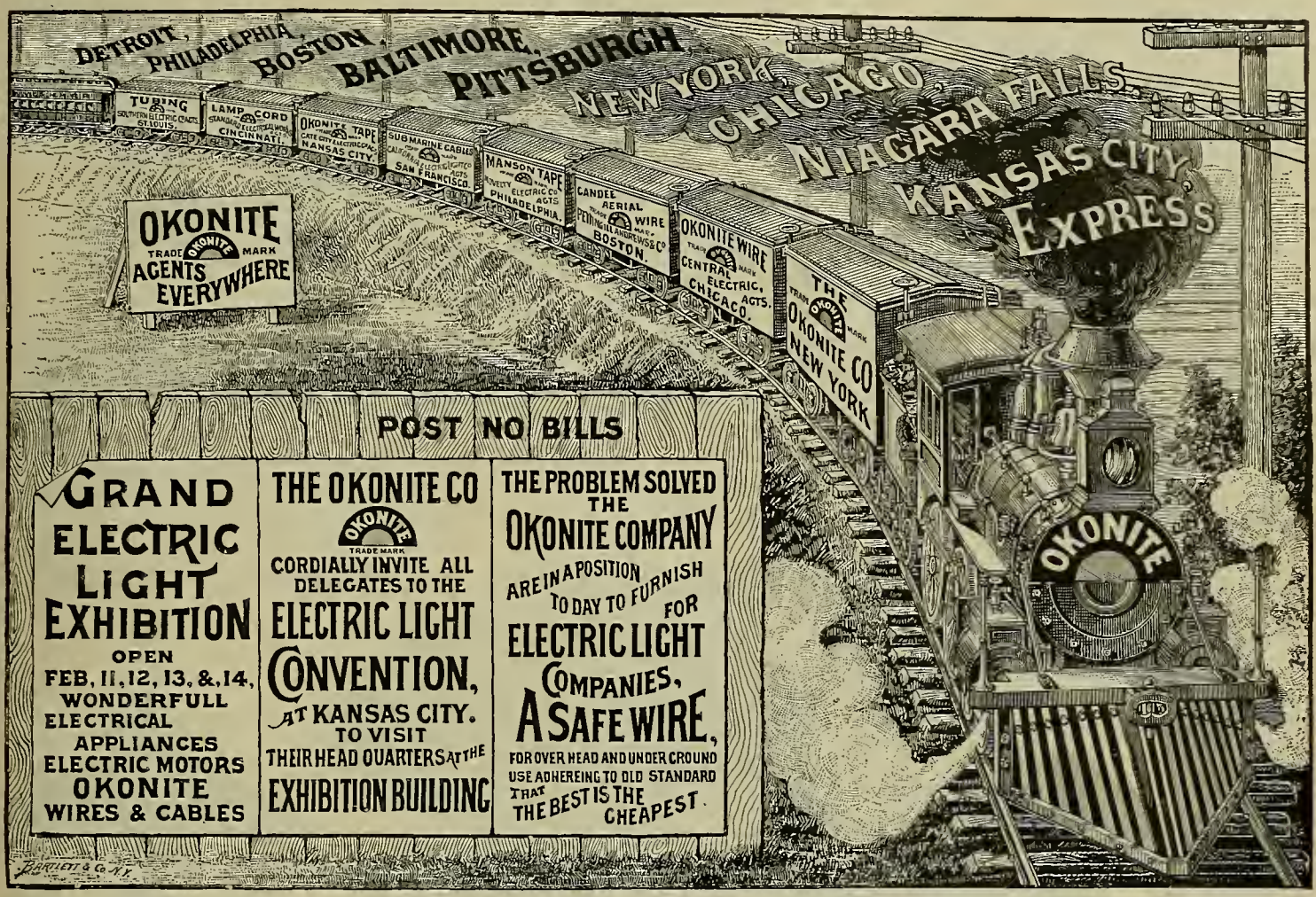

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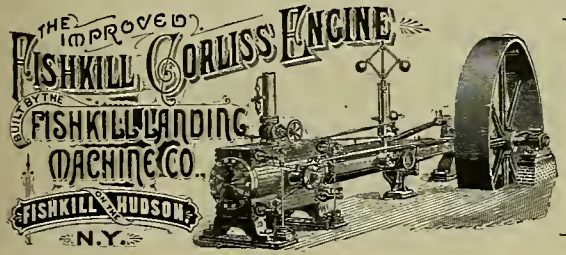

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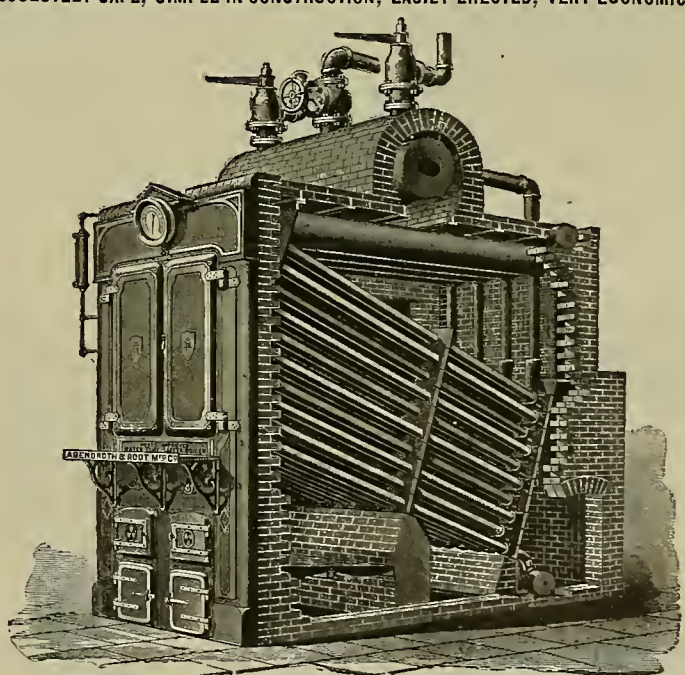

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Wires —AND— Cables.

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Are so well knowo, comment is unnecessary. Samples of any of the above furnished on application. These wires are put up on reels or coils, as desired.

OUR UNDERWRITERS' WIRE is highly polished, fire-proof and durable—equal to any in the market.

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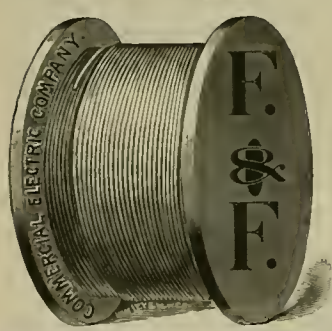

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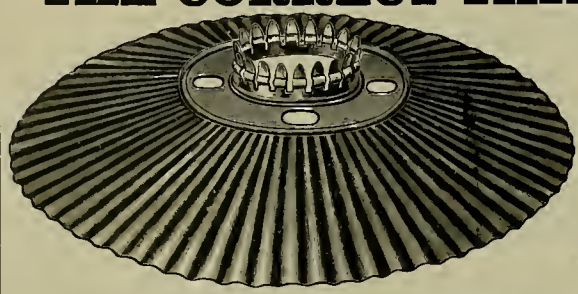

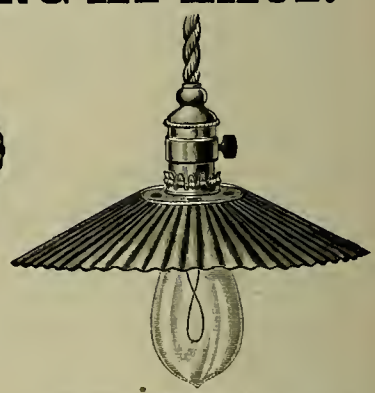

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No Light Wasted, if you use this.
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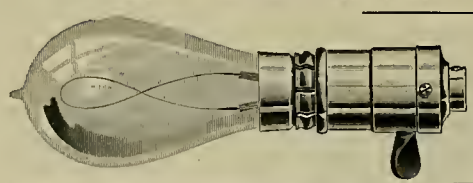

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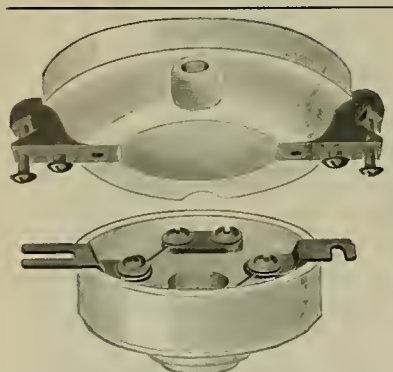

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It is Double-Pole. The Cap is Detachable, Contact Firm and Durable. Beautifully Finished in Hardwood or Porcelain. Adapted for Cleat Moulding or Concealed Work. They Are an Ornament to Any Room or Building.

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In quantities of 25 or less, net.
" " 50, 10%.....Discount.
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PORCELAIN.....40 Cents Each.

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(PATENT APPLIED FOR.)

The advantages of this Guard can be seen at a glance. It **prevents the breaking of lamps,** casts comparatively **no shadow,** requires **no shade holder,** is inexpensive, and can be placed on the socket without difficulty.

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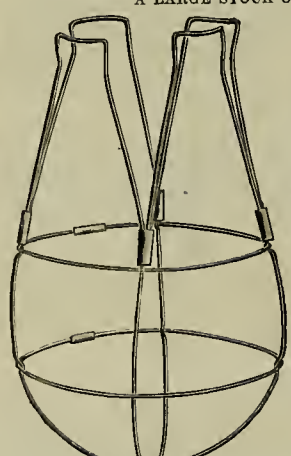

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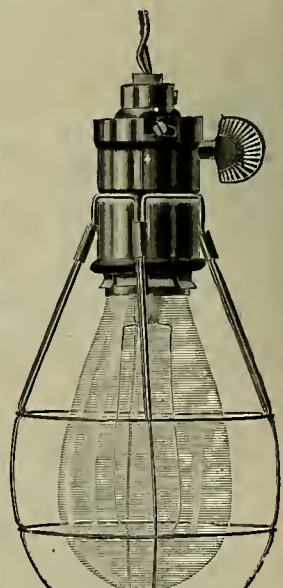

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DYNAMOS

WITH ALL NECESSARY APPURTENANCES.

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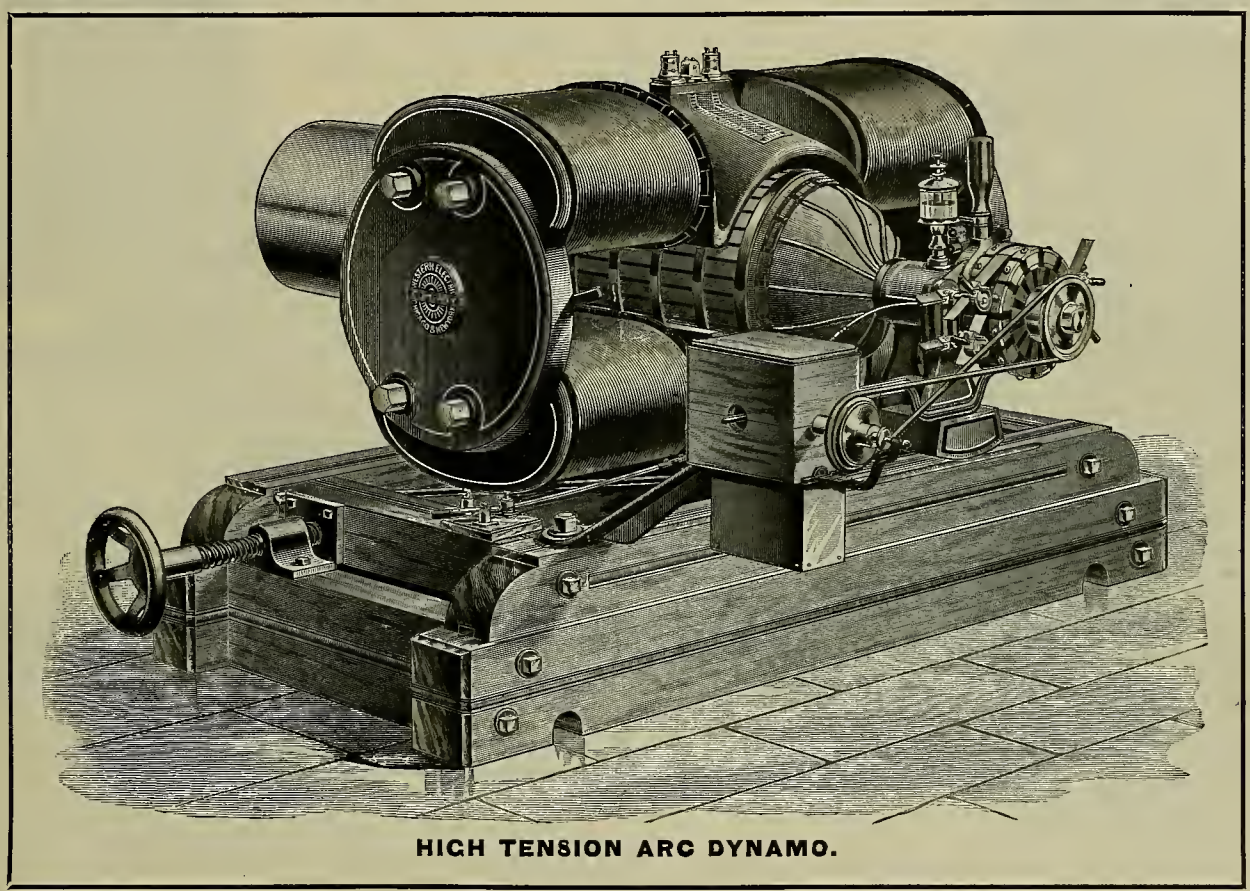

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Arc Lamps, 2000, 1500, 1200 Candle Power.

HIGH OR LOW TENSION. SINGLE OR DOUBLE.

Simple in construction, economical in operation, and perfect in regulation We are prepared to estimate on plants, either with or without power.

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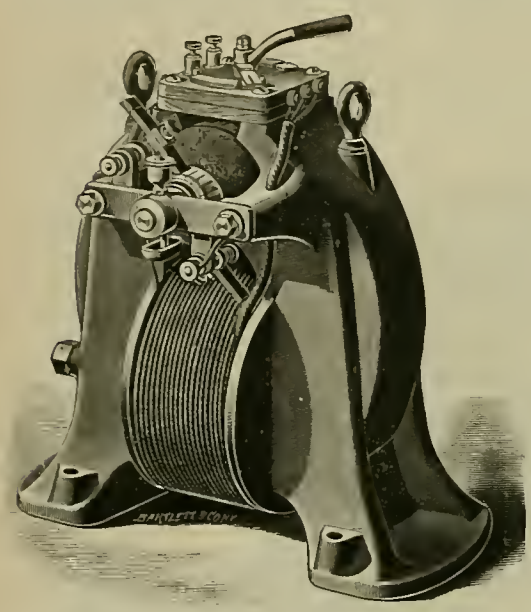
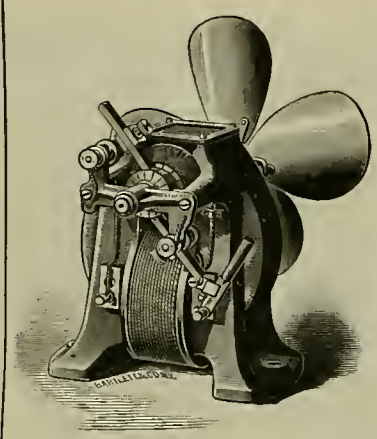
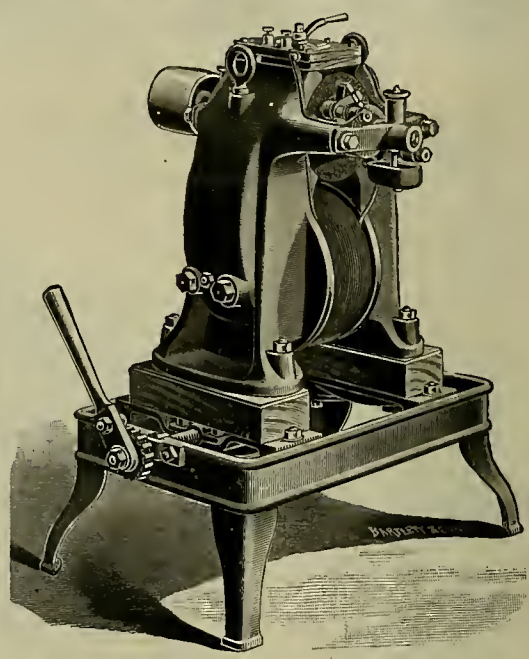


MOTOR WITHOUT BASE.



FAN MOTOR.



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Manufacturers of Direct Current Generators and Motors for all purposes, from one-eighth horse power Fan Motor up to any size, and of any Electromotive force required.

Generators and Special Motors for Traveling Cranes, Elevators and Mining Purposes.

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The Special Form of Motor made by this Company is Superior in Design and Workmanship, and Unequaled in Efficiency.

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OF THE

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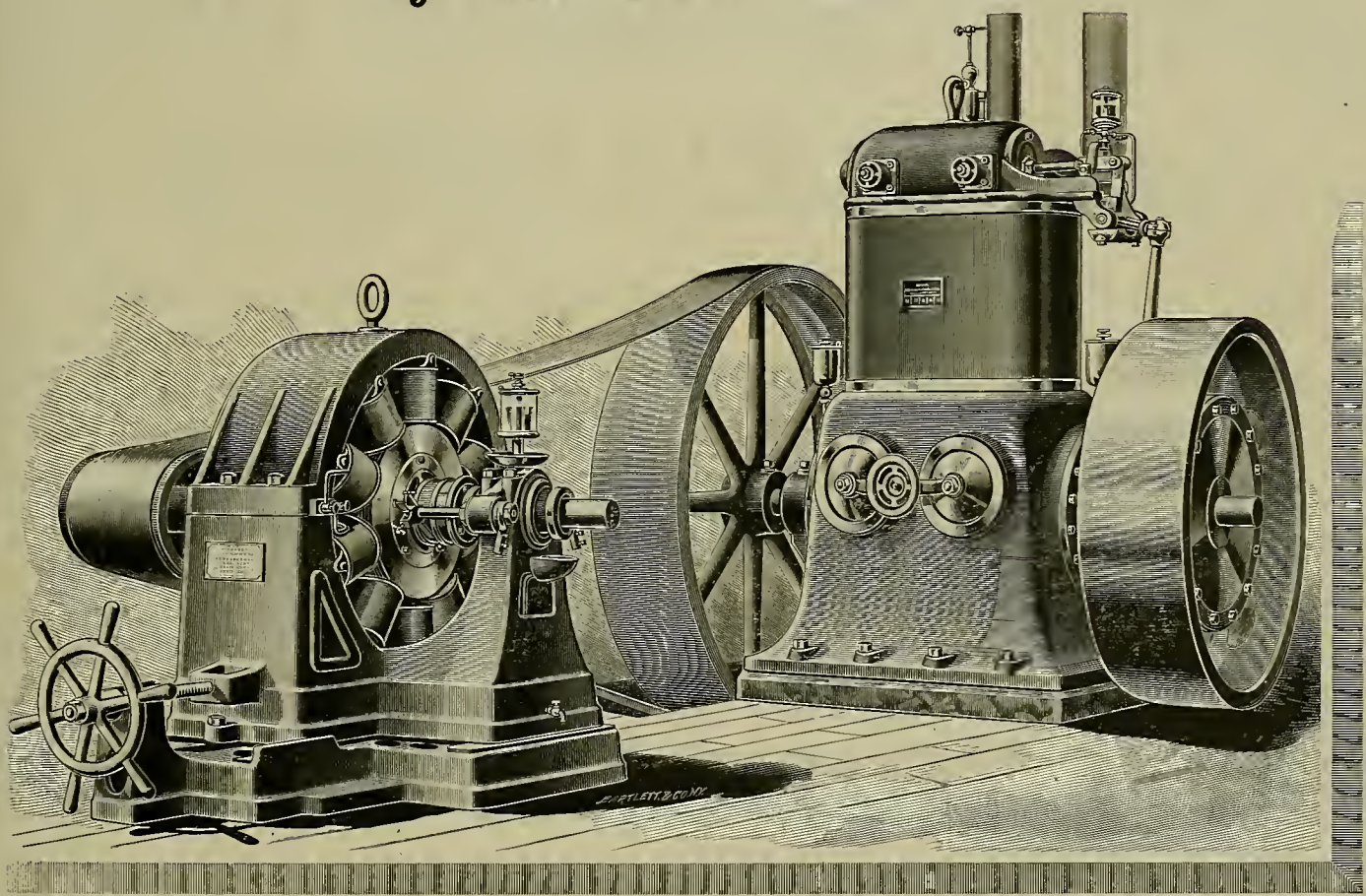
By Alternate Currents.



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RECOGNIZING THE POPULARITY OF THE

SAWYER-MAN LAMPS,

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THESE MANUFACTURERS BEING FINANCIALLY IRRESPONSIBLE

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Hereby Gives Notice that it Will Enforce

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Safety in Electric Lighting.

All systems having the main wires connected directly with wires on premises are dangerous.

With an alternating system, the lighting may be done without any electrical connection between the house wires and the main wires. A converter in an alternating system separates the mains from the house wires and constitutes an impassable barrier between the current in the high tension street wires and that used for lighting the lamps in the houses.

A perfect converter requires two coils separately wound, separately insulated, and separated from each other and the core. The converter of The Westinghouse Electric Company is the only device which fills this requirement.

A converter not only separates the street mains from the house wires, but it limits the quantity of current that can be transferred from the street mains to the house.

In an experience of 265 central stations, employing 25,000 converters, there has been no case in which any connection has been established between the current carried on the street mains and the wires in the houses, by lightning or otherwise, and there has been no case of accident to any consumer or upon the premises.

Generating Apparatus for over 300,000 Lamps sold this year.

Manufactured under Patents of Stanley, Wallace and Others.

BRANCH OFFICES:

Boston. New York. Chicago. St. Louis. Cincinnati. San Francisco.
Portland. Charlotte. Dallas.

SPRAGUE ELECTRIC RAILWAY SYSTEM.

The Pioneer of Successful Electric Railways.

The only Award given for Electric Railways at the Paris Exposition of 1889 was a GOLD MEDAL presented to the Sprague Electric Railway and Motor Company, for the most perfect system of Electric Railway Equipment.

What are the Essential Features in any Comprehensive Electric Railway System?

Main Feeders from Power Station.
Main Conductor Feeding in Trolley Wire.
Uniform Size of Trolley Wire, Independent of Length of Line, or Number of Cars Operated.

AND WHY?

BECAUSE, Thereby only can be secured **Uniform Electrical Pressure.**
Absolute Reliability of Service.
Non-interference with one section by interruptions upon any other.

The Sprague Company will guarantee to operate a ten mile Thirty Car, Double Track System with

Less Engine Power;
Less Dynamo Capacity;
Less Weight of Conductors;
Less Loss in Distribution;
Less Loss in Motors;

OR IN WORDS THAT ARE UNDERSTOOD BY ALL, WITH

More Car Miles per Ton of Coal Consumed;
More Miles of Line with a Given Loss;
More Territory Covered by a Given Outlay;
More Reserve Capacity in a Given Plant;

THAN CAN BE DONE WITH ANY OTHER SYSTEM.

FEATURES OF A CORRECT MECHANICAL DESIGN OWNED EXCLUSIVELY BY THE SPRAGUE CO:

Centering the Motor on the Driven Axle;
Flexible Yielding Support for Relief of Strains;
Universal Movement of the Trolley Pole;
Single Lever Movement for Motor Control;

NO COMPETITOR OF THE SPRAGUE COMPANY CAN MAKE A SIMILAR GUARANTEE, AND ACCOMPLISH IT TO THE LETTER.

SPRAGUE ELECTRIC RAILWAY & MOTOR COMPANY,

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THE INTERIOR ELECTRICAL CONDUIT CO.

A New and Improved Method of Equipping Buildings with an Insulated Tube Conduit for any System of Electric Wiring.

COMBINING:

SAFETY—Absolute immunity from electric fires.
ACCESSIBILITY—Perfect access to concealed wires.
ECONOMY—Small cost of installation, and freedom from future expense.
DURABILITY—Absolutely moisture-proof tube and appliances, insuring longevity of wires.
CONVENIENCE—Systems of electric wiring may be laid out on original plans in a manner similar to that employed for gas, water and steam piping; the conductors may be drawn in at pleasure.

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UNION HARDWARE CO.,
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Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

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THE PAISTE SPECIALTIES

SWITCHES

CUT-OUTS (new), GAS ATTACHMENTS (new), Etc.

Exhibited at Kansas City Electrical Convention by Mr. Wm. R. Hood.

Exhibit Found in his OVERCOAT POCKET.

LOOK HIM UP.

USE THE BEST INSULATION.

The CELEBRATED P. & B. ELECTRICAL COMPOUNDS.

Thoroughly MOISTURE and WEATHER Proof, resist the STRONGEST ALKALIES, STRONG ACIDS, FUMES and GASES; also P. & B. WATERPROOF WRAPPING and INSULATING PAPERS. We manufacture a special VARNISH for ARMATURES, and FIELD COILS.

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Western Electrician.

EVERY SATURDAY.

Vol. V. CHICAGO, FEBRUARY 15, 1890. No. 7.

Electric Lighting in Kansas City.

Kansas City, Mo., is well supplied with electric lights and several of its stations are of more than ordinary interest. In the last few numbers of the WESTERN ELECTRICIAN several of these stations have been illustrated. The engravings which are presented herewith, illustrate the other important plants in Kansas City.

AMERICAN ELECTRIC LIGHT COMPANY.

Fig. 1 gives a view of the arc light plant of the American Electric Light company, which is located at the intersection of Twentieth and Central streets. There are eight dynamos in the station, four Ball machines and four American generators. Only five of the machines are shown in the cut. The plant has a capacity of 250 arc lights.

Fig. 2 gives a view of a corner of the plant in which a Heisler dynamo of a capacity of 300 32-candle power lamps is located. The cut also shows the new Heisler regulator. The dynamo was installed about a month ago. The steam generating plant consists of three boilers which have a combined capacity of 300 horse power. The dynamos are operated by two New York safety engines and one Armington & Sims engine. The American Electric Light company was organized in February, 1888, by M. S. Porter, H. M. Porter and O. W. Ditsch. M. S. Porter is president and general manager; H. M. Porter is secretary and treasurer, and R. McMillan is superintendent. The company proposes soon to extend and improve its plant. A franchise is now before the Kansas City council giving it the privilege of extending its system, and of bidding for city lighting.

INTER-STATE ELECTRIC LIGHT COMPANY.

Fig. 3 presents a view of the station of the Inter-State Electric Light company. The dynamos are six in number as follows: Two Hawkeye, two Fort Wayne Jenney, one Rae and one Fisher. These machines supply with current 2,000 incandescent lights. The steam plant consists of five Buckeye boilers of 100-horse power capacity each, three Buckeye engines of 200, 150 and 35-horse power, and one Ideal engine of 75-horse power. The company operates a storage battery system. The 800 cells are located in five sub-stations.

The Inter-State Electric Light company was organized in 1888 with Frank K. Moody as president; John D. Cruse, secretary; M. L. Sargent, treasurer; Paul W. Bossart, superintendent. Other members of the company were: Samuel F. Scott, E. L. Martin, and Geo. M. Myers. E. P. Brink is the present president, Robert Moody is secretary, and T. F. Clohesy is the general manager.

ISOLATED PLANTS.

Fig. 4 illustrates the electric light plant in the packing house of George Fowler & Son, Kansas City. The two machines in service are a United States 110-volt incandescent dynamo of 300-lights capacity, and one Brush 60-light arc machine. The incandescent lamps used are of 16-candle power. The engine which may be seen in the back-ground in the cut, is belted directly to the dynamos, the main shaft being extended so as to accommodate the two pulleys. The middle pulley, to which the incandescent machine is belted, is provided with a friction clutch. By means of this, the last named machine can be thrown into of out of action as desired, without affecting the arc dynamo.

The Centropolis hotel electric light plant consists of two Edison dynamos which are illustrated in Fig. 5. The plant consists of one Heine boiler of 100-horse power, one Heine boiler of 75-horse power and one tubular boiler of 50-horse power, and one Ide engine of 100-horse power.

The new dry-goods house of the Doggett Dry-goods company, is lighted by 60 arc lights and 215 incandescent lamps of the Brush system. The plant which is shown in Fig. 6, is located in a space under the sidewalk, 42x9 feet, and was installed in just three weeks. The current was turned on just two days after the plastering in

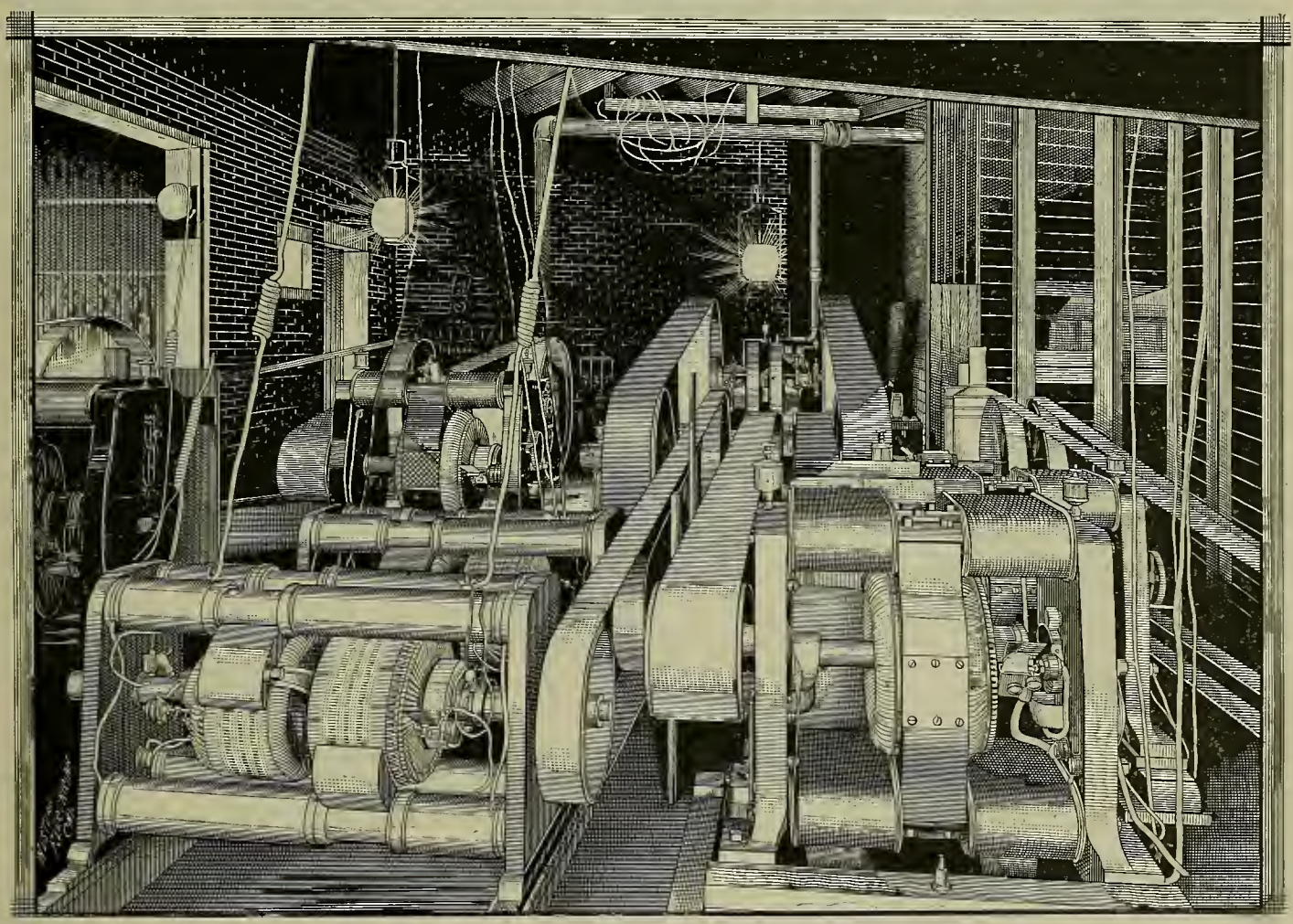

FIG. 1. ELECTRIC LIGHTING IN KANSAS CITY—AMERICAN ELECTRIC LIGHT COMPANY'S ARC PLANT.

the building had been finished. The boilers, which are three in number, are of the tubular type. They are of 80-horse power capacity each. The engine is a Reynolds-Corliss of 75-horse power. There are two 30-light arc dynamos and one incandescent machine. All the circuits, both arc light and incandescent, are connected with one ash switch-board. S. J. Rosamond, the engineer in charge of the plant, superintended every detail of its installation.

Kansas City Convention of the National Electric Light Association.

On account of the Kansas City convention of the National Electric Light association the WESTERN ELECTRICIAN is published this week several days earlier than the date which it bears. There is every reason to believe that the meeting will be successful in all respects. For the convenience of those who will attend the convention, the programme is appended:

Prof. Elihu Thomson. Subject: "Safety Devices in Electric Light Installations."

Prof. Henry A. Rowland. Subject not yet announced. Prof. Rowland has consented to present a paper based upon a correspondence with the members of the association, now being carried on by the secretary, for the purpose of ascertaining with what technical questions connected with the art of electric lighting they find the greatest difficulty.

Thomas A. Edison will give an address—the subject of which is not yet announced—by phonograph which will reproduce Mr. Edison's voice loud enough to be heard in all parts of the house. As but few persons have ever heard Mr. Edison speak in public, this address from the phonograph will be of unusual interest.

Frank J. Sprague. Subject: "Electricity as Applied to Street Railways."

F. E. Sickles. Subject: "The History and Theory of the Steam Engine."

George H. Babcock. Subject: "The Economic Generation of Steam."

Myron D. Law. Subject: "Nine Years with the Arc Lamp."

C. A. Harber. Subject: "Line Insulation from the Standpoint of Practical Experience."

T. Carpenter Smith. Subject: "A Universal System of Central Station Accounts."

A. J. De Camp. Subject: "The Cost of the Products of Central Stations."

C. J. H. Woodberry. Subject: "Central Station Construction."

C. J. Field. Subject: "A Recent Edison Central Station and the Results thus far Obtained."

Henry W. Pope. Subject: "How Our Paths May be Paths of Peace."

C. C. Haskins. Subject: "Prodigality in Economy."

E. F. Peck, in the discussion of M. L. Law's paper, will give the results of his numerous tests of arc light carbons.

Reports will be made by the following committees:

The executive committee, G. W. Hart, chairman; committee on patent legislation, Arthur Stewart, chairman; committee on underground conduits and conductors, E. T. Lynch, Jr., chairman; committee on harmonizing electric light and insurance interests, P. H. Alexander, chairman; committee to confer with Mayor Grant in regard to the international exposition of 1892, Dr. Otto A. Moses, chairman; committee on electrical data, A. R. Foote, chairman; committee to memorialize congress on the abolition of customs duty on copper, C. A. Brown, chairman; committee on electrical execution, E. W. Maher, chairman; committee on standardization of potential on electric street railways, E. T. Lynch, Jr., chairman; national committee on state and municipal legislation, A. R. Foote, chairman.

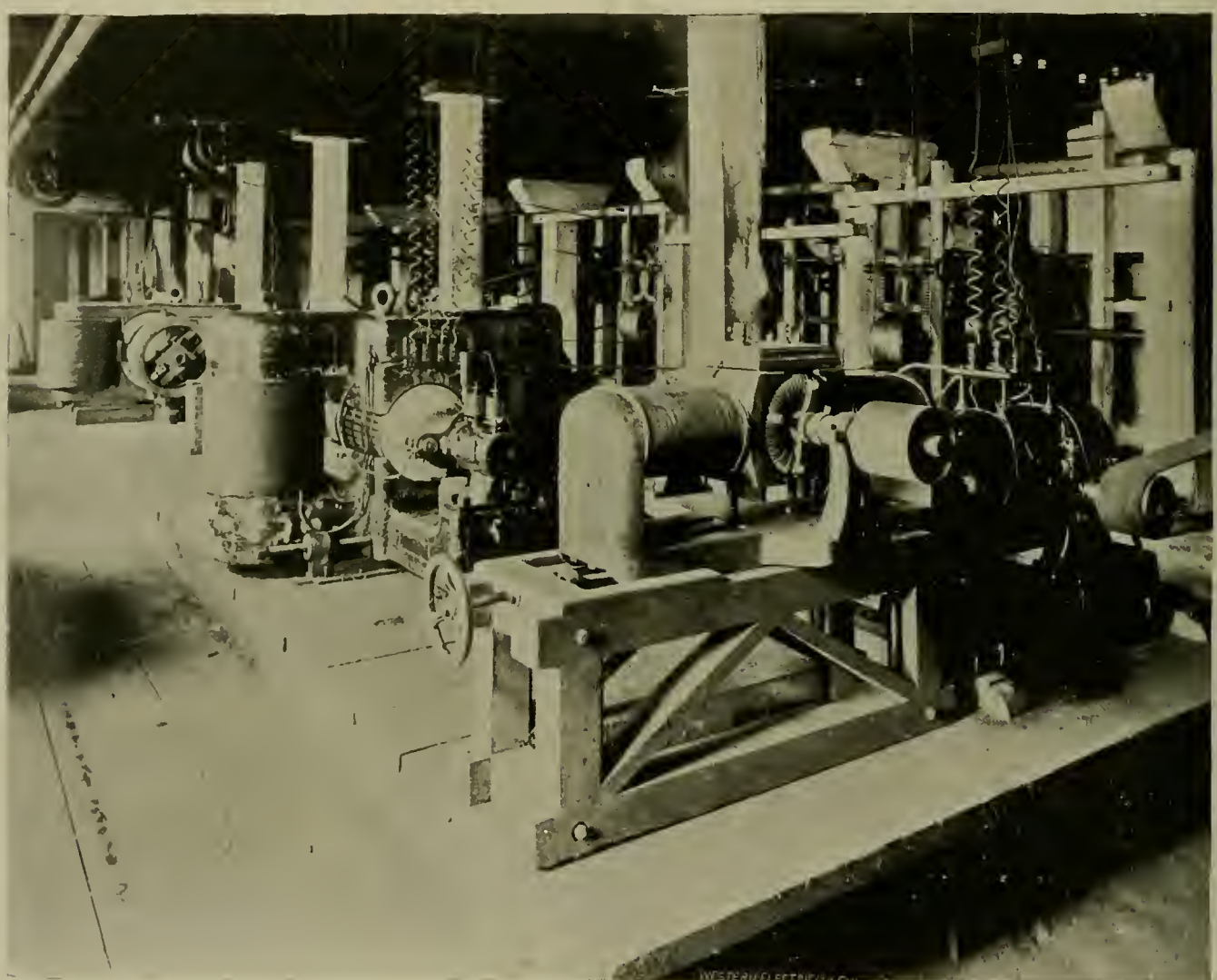

FIG. 3. ELECTRIC LIGHTING IN KANSAS CITY—INTER STATE ELECTRIC LIGHT STATION.

Rapid Transit for St. Louis.

The announcement that a powerful company had been organized to furnish a complete rapid transit system in St. Louis, served to awaken considerable interest in the scheme, and when it was further announced that elevated roads would be constructed for the business portion of the city with cable or electric lines for cross town traffic, it was agreed that St. Louis had solved the rapid transit problem. It now appears that the announcement of this scheme was premature. The elevated road project fell through for want of financial backing, but it was afterward announced that cable lines would be introduced by Chicago capitalists, known as the Holmes syndicate. In order to do this it was found necessary to secure possession of an old franchise for putting down cables. This franchise was granted two years ago and will expire in a few months unless the company takes advantage of it. The residents of St. Louis are not satisfied with this arrangement. One instance of this opposition is related in the following dispatch from St. Louis: "A pronounced opposition to the laying of cable tracks on Broadway is springing up in North St. Louis among the property-owners along the route, who prefer the overhead electric wires to cable tracks on the street. The objectionable feature of the cable track is the open slot and flat rail in the middle of the track which the North Broadway people consider would prove injurious to the vehicle traffic on the street. This is the line which is owned by the Holmes syndicate of Chicago, which decided a few days ago to cable the entire line."

The directors of the Benton-Bellefontaine Street railway, St. Louis, held a meeting a few days ago and decided to solicit bids for the equipment of its line with electrical motive power. The company has a franchise to equip its line with electricity from Cass avenue northward, and it, like that of the Broadway line, will expire unless work is begun by April 4. It is the intention of the company to extend the tracks of this line northward to the cemeteries in the near future. Electric motor cars will be used on the full length of the line.

Joint Ownership of Poles in Cincinnati.

The board of public affairs in Cincinnati has adopted a novel rule in regard to the erection of poles for electric wires in that municipality. Under this rule but one line of poles for electric light and power purposes can be put along each street, and so far as possible, the lines must be confined to the side streets and alleys. The company which first secures the right of way can

locate its poles under the direction of the board, and place upon them such cross irons and wires as it desires. Should a second company wish to run a line along the same street it has the privilege, after obtaining the necessary permission from the board, of attaching its cross irons and wires to the poles of the first company. The second company is obliged to pay to the first company one-half of the value of the poles.

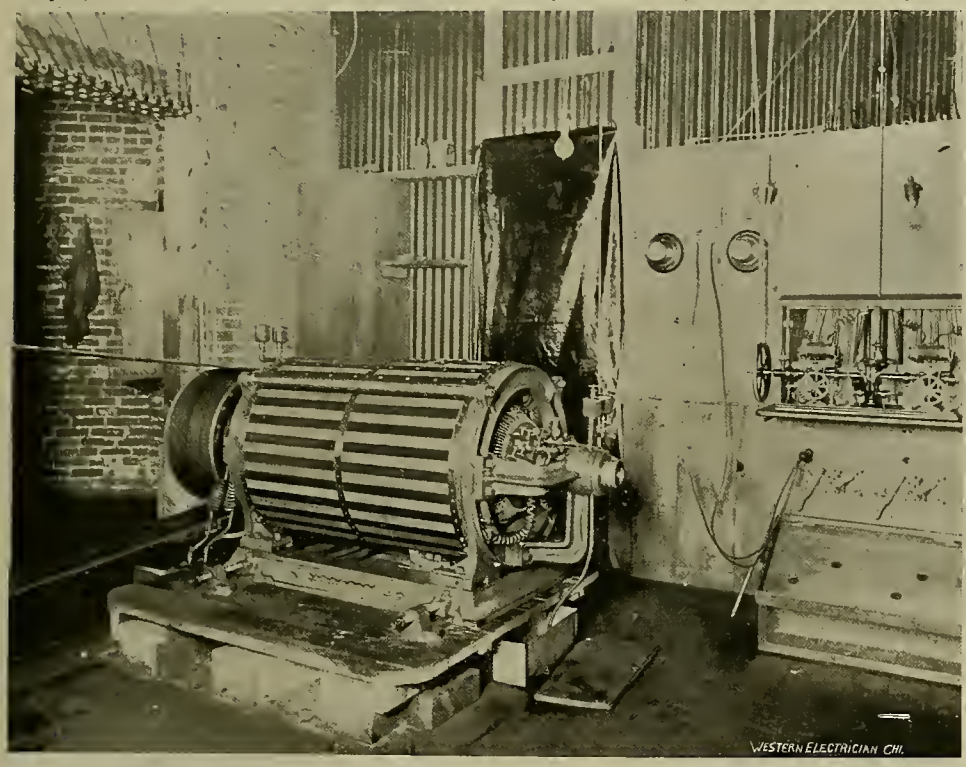

FIG. 2. ELECTRIC LIGHTING IN KANSAS CITY—HEISLER DYNAMO AND REGULATOR IN THE AMERICAN ELECTRIC LIGHT STATION.

The board acts as arbitrator in fixing the value of the poles. Should a third company desire to string wires along the same street and occupy the same pole, it can do so after obtaining the necessary permit, the board as before acting as arbitrator in fixing the value of the pole, and the new company pays each of the other companies one-sixth of the value. This rule to be extended to the limit of the carrying capacity of the pole. Should that be exceeded, the pole must be replaced by a new and larger one. The theory is that each company occupying poles should have equal ownership and equal rights on all the poles along any right of way. Great opposition is made to the policy by several companies, who assert that the rule will work an injustice to them. A number of injunction suits have been filed by the Brush company against the Jones Bros.' Electric company, and others are in contemplation by the light and power companies of the city. The outcome and practical operation of this rule will be watched with interest by the entire electrical fraternity.

A Makeshift.

By Prof. J. E. Davies.

Possibly many of the readers of the Western Electrician who have tried the usual method of Kohlrausch for determining the resistances of electrolytes with an alternating current and a telephone bridge, have experienced the annoyance arising from the noise of an induction coil. When used as a source of alternating current, even if placed at a distance or in another room, the coil is often loudly intrusive when one is trying to judge accurately of the neutral point in the telephone. Having no access to any other source of alternating current, like myself, they may not for that reason have used the method as much as they otherwise would. I have thought it might not be uninteresting to describe a simple makeshift which I have for some time found convenient. In view of the present plentiful distribution of so-called continuous current dynamos, this makeshift may prove useful for many other purposes where a gentle alternating current of almost perfectly steady periodicity is required; as for example, in Lord Rayleigh's induction balance for studying the changes in resistance and impedance of wires carrying alternating currents, and the like. In my own case, having an Excelsior dynamo running at 1,050 revolutions per minute with sixteen sections to the armature coils and double brushes, I have 1,760 fluctuations per second, which I utilize as follows: In any convenient place on the dynamo line I place a helix of heavy wire and many turns, and within this I put an iron core. Over the core I slip a secondary coil of any convenient size, according to the loudness of the current I desire, and conduct the secondary current produced in this coil by the pulsations of the dynamo in the primary, to an ordinary Kohlbrausch cylinder bridge where I use any self-made telephone receiver as a detector instead of a galvanometer. In this way one can determine very rapidly the resistance of batteries, polarizing solutions of all sorts, and of course ordinary wire resistances. The primary coil on the dynamo circuit may be placed only a few feet from one's table, being thrown in or out by a switch as desired, without the noise of the primary coil interfering with that heard in the telephone. In view of the annoyance caused in our telephones by adjacent electric light wires, there is a sort of justice in utilizing their fluctuations in this way whenever their wires come within reachable distance of one's laboratory, or workshop, as they frequently do. On testing an adjacent Thomson-Houston line in this manner I get a much lower note, due of course to the slower speed and their three-part commutator. One need not insert a coil even in the dynamo's circuit, but merely wrap a sufficient number of turns of thoroughly insulated wire around the straight wire of the dynamo and connect this with the telephone coil. The induction will be sufficient for most purposes, and no injurious induction or impedance will be thrown back on the primary line.

As a source of alternating current of small strength easily obtained, and avoiding the trouble of batteries, induction coils, etc., and having moreover what is so desirable in many experiments, that is, a definite periodicity whose value is quickly determined, it occurred to me that although many of your readers had doubtless resorted to it and used it for a long time, there might be others to whom the suggestions would not be without interest.

Electric Lighting in Chicago.

By John P. Barrett.

The inception of our underground system in Chicago occurred in 1878. The city electrical department erected a new pole route through one of Chicago's select residence districts. The residents strenuously objected to the poles, and a committee of their number waited upon me in reference to the matter. I stated to them that the line might be placed underground, but that the city did not furnish the means for so placing it. They volunteered to defray the expense and the poles were removed and 840 feet of two-inch wrought iron pipe was laid about three feet below the surface and the exterior of the pipe treated with a liberal amount of tar and linseed oil. In this pipe two kerite wires were placed. These wires are in service to-day, and are giving as good service as the day they were placed under ground. We have had no occasion to touch them and they have not deteriorated to any appreciable extent. From this date on the underground question was agitated, and in 1883 the common council passed an ordinance requiring all electric conductors to be placed underground. In accordance with this ordinance the various companies doing business in the city, after exhausting all means to evade it, adopted various systems for placing the wires underground, *viz.*: Dorsett conduit, Johnstone conduit, iron pipe, wooden boxes, in which cable was placed and the space between the box and cable was filled with bituminous concrete, conduits of creosted wood and vitrified sewer pipe. The city took the initial steps, and up to the present date has placed underground 20,441 feet of conduit, 474,097 feet of iron pipe, 1,200 feet of wood trough, 126,443 feet of cable from 5 to 40 conductors, 120 miles electric light, 65 miles single wires, with 263 manholes, 168 handholes. The various companies have placed underground 65 miles of conduit, and 5,000 miles of wires.

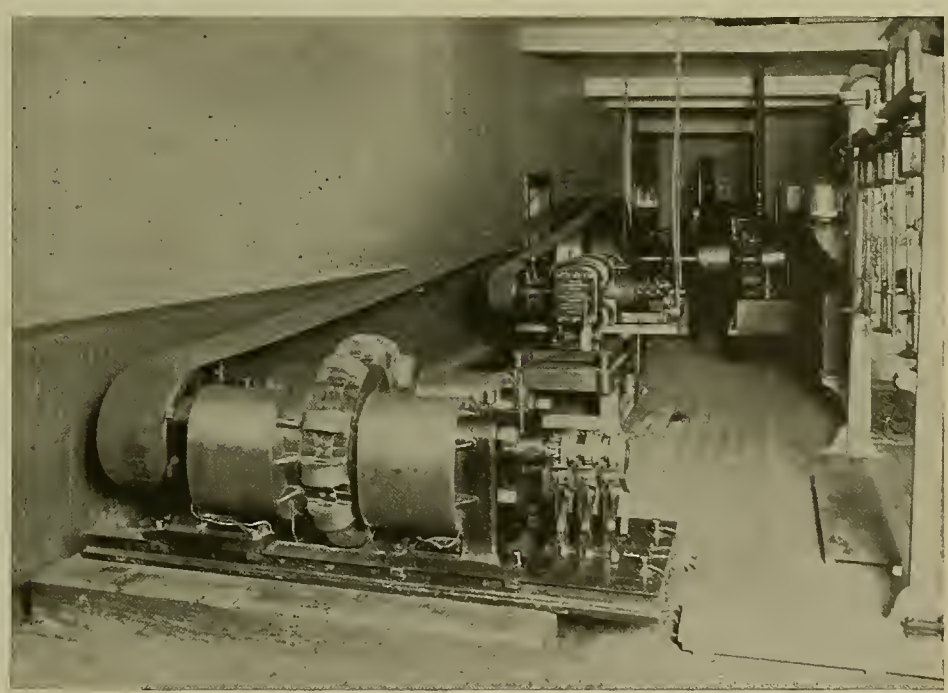

FIG. 4. ELECTRIC LIGHTING IN KANSAS CITY—ELECTRIC LIGHT PLANT IN THE FOWLER PACKING HOUSE.

The wire so placed underground embraces all branches of the service, *viz.*: telegraph, telephone, police, fire alarm,

electric lighting, etc. In 1879 I installed a two-arc dynamo in the North Side water works, and placed two arc lights on the cupola of the water works tower, with a view to experimenting with electric lights from an elevated point. This, I think, was the origin of the present tower system in use in this country, and was the first public electric light operated in the city of Chicago.

The first central station plant was installed in 1881, with 40 lights, and that number has increased to date to 6,300 lights, representing an investment of over $2,000,000.

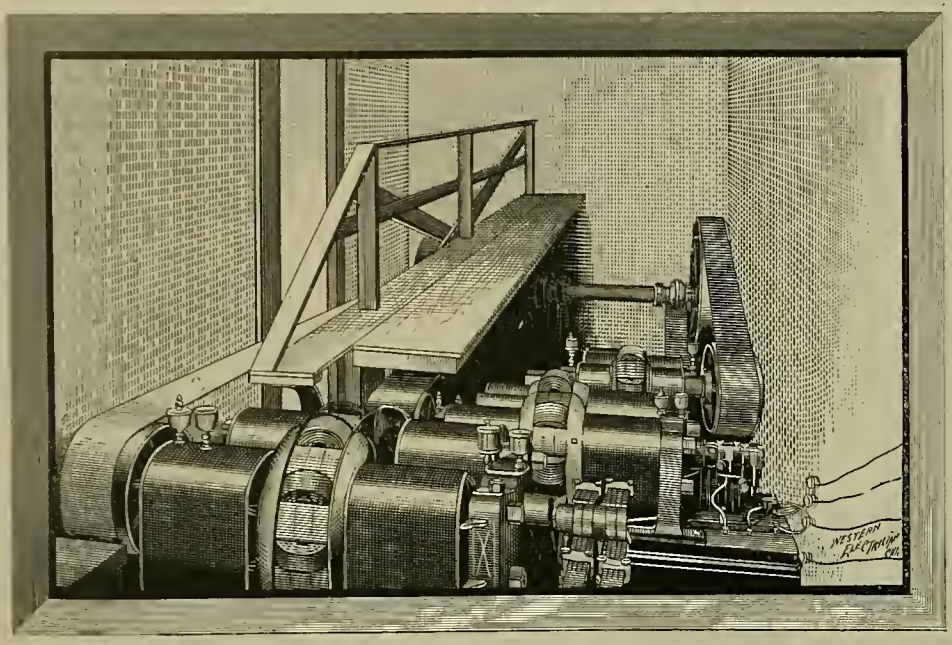

FIG. 3. ELECTRIC LIGHTING IN KANSAS CITY—DOGGETT COMPANY'S PLANT.

All electric light and power wires are subject to a rigid inspection under city ordinance—the inspector being appointed by the superintendent of city telegraph. All electric light wires in the city are underground. Telegraph, telephone and electric light wires are placed in the same conduits. In 1883, a franchise was granted the Sectional Electric Underground company to build underground conduits for commercial purposes. This company built about seven miles of conduit in the business district of the city and rents space in the same at the annual rate of $1,000 per mile per duct, the city being allowed the use of one duct free of charge.

In 1887 it was decided to install an arc plant for lighting the bridges and the Chicago River. The cable was placed in a two inch iron pipe and laid underground between the dock and building line, and divided into four circuits from three to five miles in length operating 105 2,000 candle power arc lights. The following year a street lighting plant was installed and consolidated with the original plant, making twelve circuits from one to five miles in length. The potential of the original four circuits was from 800 to 1,100 volts. The twelve present circuits range from 350 to 1,100. Each conductor carries a current of from 18 to 20 amperes. The apparatus used is of the low tension pattern. We have in use five different sizes and makes of cable, viz.: Patterson, Cebb, Waring, Keith and Okonite. The cables for the street lighting plant were placed in conduits of various kinds, viz: Iron pipe laid in the earth without other protection, iron pipe laid in concrete, iron pipe cement-lined laid in concrete, Dorsett conduit which consists of multitubular blocks of bituminous concrete about four feet long. Manholes are built of brick and are placed from 230 to 450 feet apart, of a rectangular shape, averaging about 46 inches long by 40 inches wide by 4½ to 9 feet deep with double iron covers one of which is set below the grade and made water-tight by packing, the other set on a level with the street. All the iron pipe was carefully plugged to remove burrs and reamed at ends.

All the conduits and pipes are laid with a pitch or difference of grade from 6 inches to 1 foot, so as to drain into the manholes, thus disposing of all drip from condensed moisture. The conduits are practically gas and water tight. In support of the practicability and safety of underground wires I desire to submit the following facts: We have had in service one of the city telegraph lines for the past twelve years 840 feet of underground wire placed in iron pipe, which has given us excellent service and has not materially deteriorated. We have had in successful operation for the past two years a circuit about five miles in length, carrying a current of 18 amperes at a potential of from 1,000 to 1,100 volts. We have had in successful operation for the past year 53 miles of electric light cable which has given us no trouble. In the various circuits used for the city telegraph, telephone and electric lighting, we have wires and cables made by five different companies, over six miles of conduit, manholes, handholes, etc., and have not had a burn-out or gas explosion. In 1887 a company, known as the Chicago Arc Light & Power company, was incorporated, and purchased all the plants then operating in the city and also the franchise of the Sectional Electric Underground company. This company does commercial lighting, exclusively underground, and is successfully working circuits at a potential of from 2,500 to 3,000 volts. The longest circuit in use by that company is seven miles and is carrying 2,500 volts. Two circuits have been connected by the company and, carrying 3,741 volts, have run all night without injury. Encouraged by the success of the street lighting plant which was installed last year, it was decided to light the entire city in a similar manner. The city was divided into twelve electric light districts. Each district is to have a power station located as near the center as possible; from each power station a main subway is to be built extending across the district from boundary line to boundary line, decreasing in duct space from power station toward the boundary line; from these feeder connections are made to the lamps. On all streets where fire or police boxes, engine houses or police stations are located, enough duct space has been provided to accommodate the underground wires necessary for these departments. During the past year this department has built 13,838 feet of main subways; some consisting of multitubular blocks of bituminous concrete laid on concrete foundation of Portland cement, sand and limestone screenings; some consisting of multitubular blocks of bituminous concrete surrounded on all sides with three inches of concrete composed of Portland cement, sand and limestone screenings; some consisting of wrought iron cement-lined pipe laid in concrete composed of Portland cement, sand and granite screenings. There have also been laid 292,552 feet of two-inch iron pipe, under sidewalk space for feeders. There have been drawn into subways and feeders 66 miles of electric light cable, 366 lamp posts have been erected and three power houses equipped with the necessary machinery and electrical apparatus have been built. Three-fifths of the electrical apparatus is of the high tension pattern. In contracting for electric light cables a guarantee was required that the insulation resistance should not be less than 500 megohms per mile and that they should not materially deteriorate for the space of two years after being in service on an electric light circuit having a voltage of from 2,500 to 3,000 volts and a current of from 9 to 12 amperes; or a voltage of from 900 to 1,200 volts and a current of from 18 to 20 amperes. The cables are placed in the conduit by manufacturers. An electric light post possessing some peculiar advantages, has been designed and adopted. It consists of a hollow iron base extending from the sidewalk to a height of seven feet. A hollow wooden pole extends through the iron base to a height of nine feet above the iron base; the iron post is firmly secured to the top and bottom of the iron post. There are two doors on opposite sides of the iron base, at a height of five feet from the sidewalk and a removable panel is located near the bottom. A frame and hood extend from the top of the wooden pole and have but one standard or support. Inside of one of the doors if placed a wooden box containing a double-pole arc light switch. In the other door is a receptacle for a fire alarm box. The panel can be removed to facilitate the handling of cables. The advantages of this pole are many: first and pre-eminent in importance is the safety it offers to human life, as in case of accident to the lamp, the workman can entirely disconnect it from the rest of the circuit without a possibility of contact with the conductor, by throwing the switch near the base of the pole. The wooden pole is a semi-insulator and is much safer to work from than an iron pole, should it be necessary to regulate the lamp while burning. The hollow space between the iron and the wooden pole offers a receptacle not only for an electric light switch and fire alarm box, where the latter is needed, but if in the future the city should need incandescent lights for city or private use, there is room for a converter by which a high tension current can be changed into a low tension current for incandescent lighting. The single standard or support for the lamp only gives off one shadow and that can be directed against the part of the nearest building where it will be the least objectionable. We have ventilated our South Side conduit by running a pipe from the mouth of the conduit to the chimney in the City Hall. This has proved to be the most practical scheme for ventilating conduits that has come within my experience, and is one that can be readily and cheaply applied in any portion of the city. The lights operated by the city are operated all night every night in the year and cost about 18 or 19 cents per night. I consider it practical to place electric conductors underground and think it the only safe place for heavy conductors such as are required for the transmission of light and power. Our experiments with underground wires commenced in the early stages of the art, and up to the present time we have been very successful, and I have no hesitation in asserting that we can work them to as high a voltage as would be considered safe on aerial lines. The only objection that can be raised against underground wires, to my mind, is simply the matter of first cost. As an off-set to this objection, the service is more reliable, being removed from atmospheric influence or interference, needs less repairing and consequently is cheaper in the end. I have found this to be true after a long experience with both.

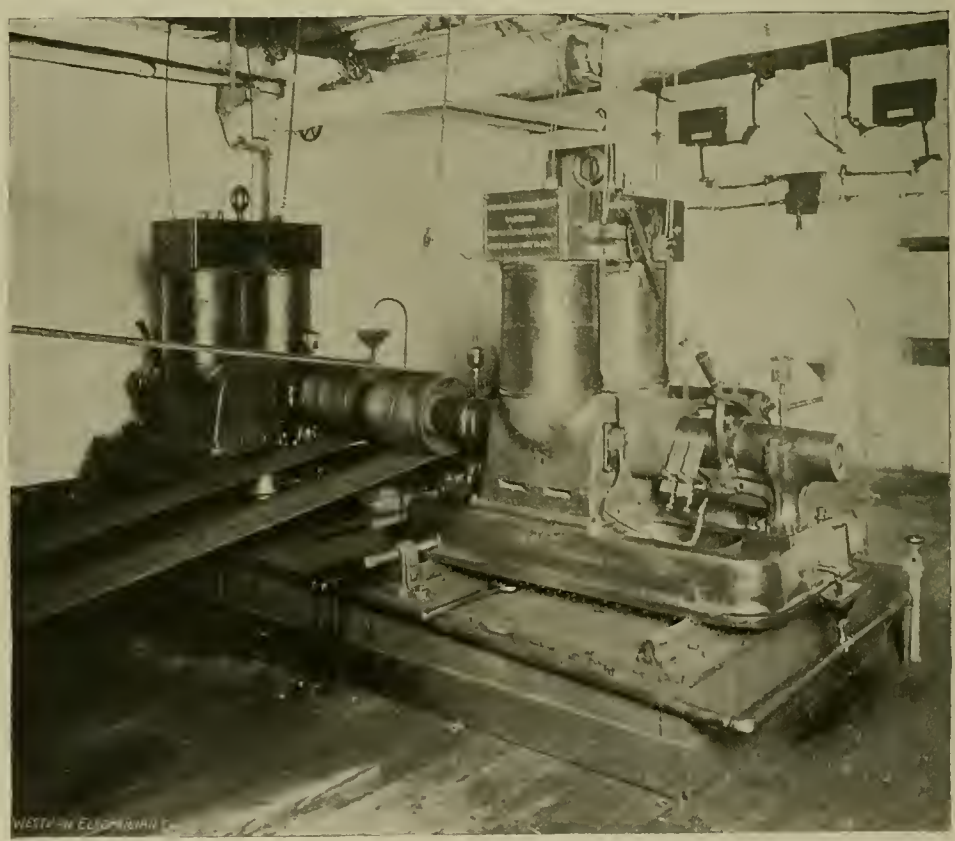

FIG. 5. ELECTRIC LIGHTING IN KANSAS CITY—CENTROPOLIS HOTEL ELECTRIC LIGHT PLANT.

The Time Electric company has been incorporated at Cleveland, O., with a capital stock of $10,000.

Eddy Electric Motors.

The Eddy Electric Manufacturing company has recently brought out a new form of motor, Fig. 1, which embodies all the best features of the well-known ring form. Many of the details of construction are the same as in the ring form. The main difference is in the shape of the magnet. This has been altered so as to permit of winding it for high voltages. These motors are made reversible, when desired. Where it is necessary to have them mounted on a metal base, they are set in a position different from that represented in the cut—*i. e.*, reversed.

Fig. 2 represents the new Eddy reversing motor in combination with the Holyoke hoist. This hoist is very light and efficient, and is well adapted to mine, dock and building work. It is made with both single and double drum. In Fig. 3 is represented the new Eddy slow speed reversing motor in combination with Holyoke safety freight and passenger elevator. With this combination, which occupies a floor or ceiling space 2½ feet by 5 feet, the amount of friction is reduced to a minimum, no belts, pulleys or countershaft being used. For passenger service, it is claimed, a speed of 200 feet or more per minute can easily be obtained. By the use of an Eddy reversing motor, which starts or stops with the elevator, the same smooth, easy motion is secured, as by the use of hydraulic power. The ratchet wheel and pawl engaging with the car acts as a positive stop for it should the current fail or should any of the gears be broken. Its action is independent of the operator. The motors are put on the market by the Eddy Manufacturing company of Windsor, Conn.

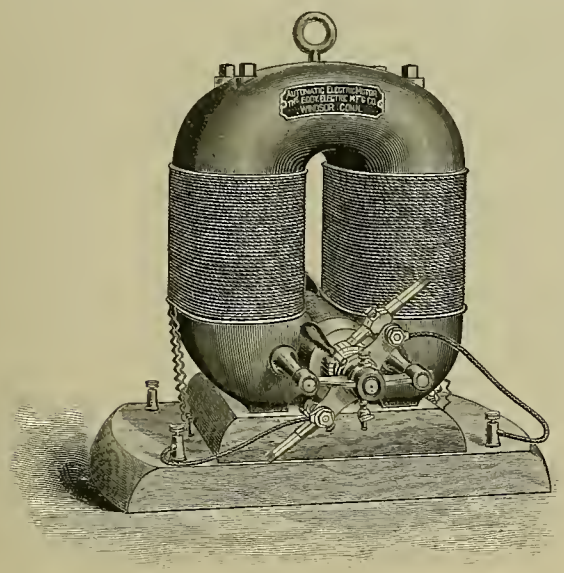

FIG. 1.

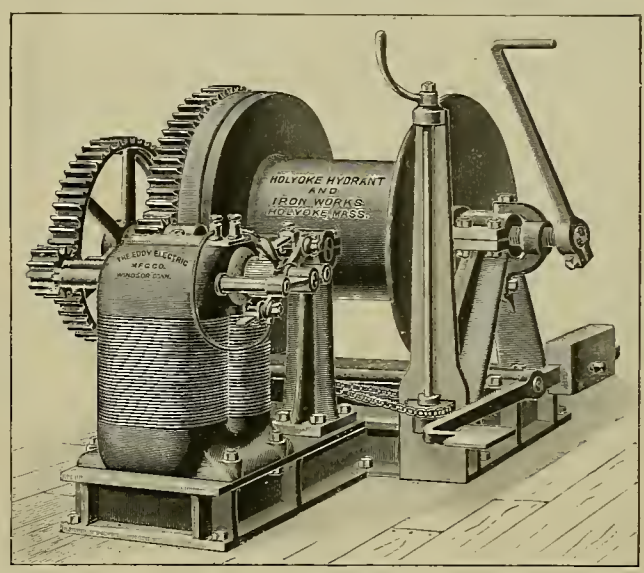

FIG. 2.

EDDY ELECTRIC MOTORS

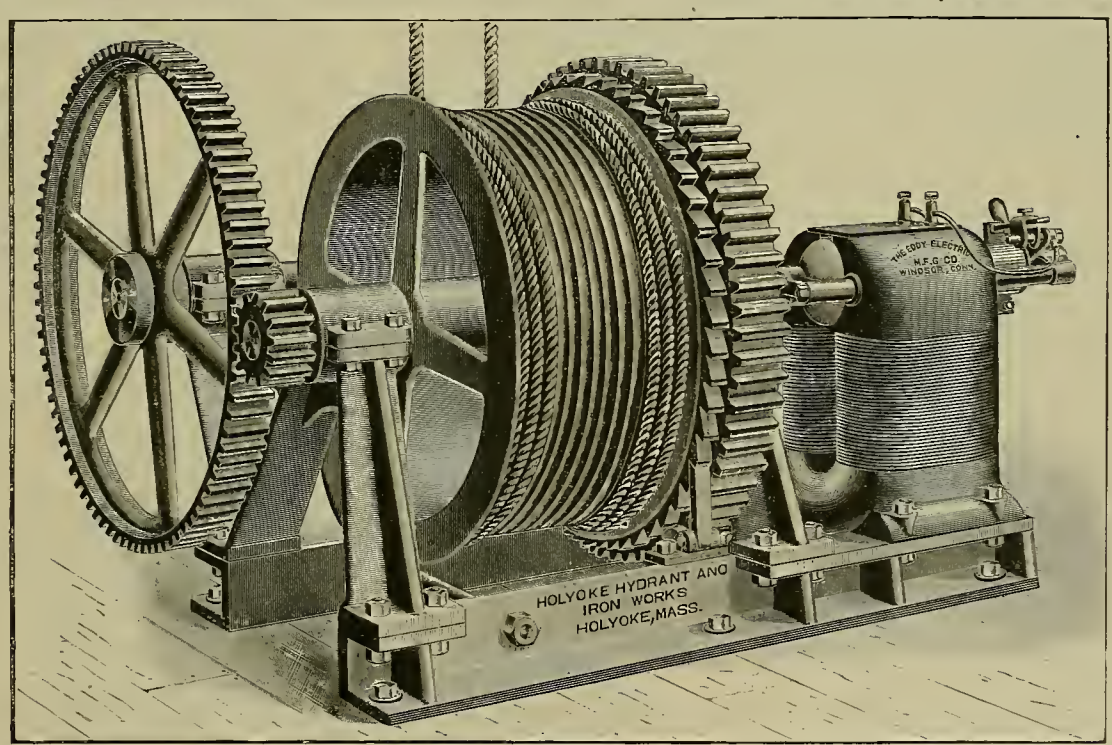

FIG. 3. EDDY ELECTRIC MOTORS.

Underground Wires in Ohio.

In the Ohio legislature last week Mr. Benfer introduced a bill in the House, which compels electric light companies erecting plants in Ohio to conduct all wires under ground, and when necessary to elevate them to street lamps, the wire shall be incased and have perfect insulation. All wires now conducted on poles must be put under ground within six months after the passage of the act. A failure to comply is punishable by a fine of not to exceed $100, and a second offense is subject to a like fine and imprisonment from thirty to sixty days. A singular fact in connection with this bill is that Mr. Benfer comes from a county in which there never has been an electric light, and it is said of the author of the bill that the first electric light he ever saw was when he went to Columbus a month ago to be sworn in.

An electric light wire came in contact with a telephone line at Cincinnati, O., recently, and besides frightening the operators burned out a number of drops. The damage, however, was easily repaired.

Reception at the Chicago Electric Club.

The "Electric Limited" train from New York with the Eastern delegates to the Kansas City Electric Light convention, reached Chicago last Monday morning. The party was joined by a considerable number of delegates in Chicago, and the entire delegation was entertained by the Chicago Electric club at its club rooms. Lunch was served from 11 o'clock until the guests departed for the train for Kansas City. Music was furnished by a mandolin orchestra. The reception, which was entirely informal, was attended by over 250 guests and club members, and was successful in every respect.

The Phonograph.

Erastus Wiman, who never seems happier than when exploiting something, has come out as a champion of the phonograph and graphophone, says the New York *Sun*. This is what he poured into one of them the other day: "For an over-worked business man like myself I consider that no greater boon could be furnished than to have beside him a silent but ever ready receptacle for what he has to dictate or say. I am using one of the phonographs in my house, and often when I am pressed with correspondence or with some literary work I turn to it and dictate what I have to convey to my friends; then bring the cylinders to the city with me. An expert typewriter interprets their contents. At my side at my business in the city a graphophone always ready, and the piles of correspondence which crowd my desk are disposed of in no time at all. I look forward to the period when one-half the correspondence of the country will be not only dictated to the phonograph, but absolutely conveyed by cylinders in boxes through the mails."

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - } Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 125 TEMPLE COURT, NEW YORK.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate and will be promptly furnished on application.

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THE Chicago Electric Club on Monday last entertained at its club rooms the Eastern delegates to the Kansas City convention of the National Electric Light association. The delegates thoroughly enjoyed this pleasant break in their journey.

THE next issue of the WESTERN ELECTRICIAN will contain a stenographic report of the eleventh convention of the National Electric Light association. As a large number of important topics are to be discussed at the meeting, the number will be of marked interest.

THE representatives of the New York electric light and subway companies have conferred with the corporation counsel, and the result is a complete back-down of the subway company in its position that the board could not grant a permit to any other construction company to build its conduits. The corporation counsel is considering the question, and it is hoped that his decision will permit the building of enough subways to accommodate the wires of the electric companies.

THE committee appointed at the last convention of the National Electric Light association to memorialize Congress to abolish the duty on copper, has performed its duties admirably. It has presented the matter to the House Committee on Ways and Means, before which body one of the members made an address summarizing the arguments in favor of a removal of the duty. One of the results of the committee's work has been the appearance in a number of newspapers of articles recommending the abolition of the tariff. In several instances the articles were published in papers which are noted for their unfaltering support of the doctrine of protection. The committee has worked faithfully, and should be supported heartily by the association.

IN the last few numbers of the WESTERN ELECTRICIAN a series of views of electric light stations in Kansas City has been presented. In view of the fact that the convention of the National Electric Light association was to be held in that city, it was believed that these views and the accompanying descriptions would be of special interest. In the present number views of five additional stations are presented. These complete the list of the more interesting plants in Kansas City.

A SINGULAR bill has just been introduced in the Ohio legislature, the outlines of which are given in another column. The author of the bill proposes to compel electric light companies in Ohio to bury their wires under penalties of fines and imprisonment. No distinction is made between city and country. It is an interesting fact that the author of the bill hails from a county in which no electric lights are operated, and that he never saw an electric light until a few weeks ago. It is unfortunate but but nevertheless true that a great many of the measures relating to electrical matters are proposed by men who know as little of the subject as this Ohio legislator.

A REPORT of the discussion of Elmer A. Sperry's paper on "Operation of Electric Motors with High Tension Currents," is presented in this issue. It will be remembered that this paper was read by the author at the last meeting of the Chicago Electric club. The discussion was quite spirited. The tenor of the paper was in favor of the constant current motor, hence, as a matter of course, the constant potential men came to the front as champions of the last named system. A number of interesting points concerning both the generator and motor of the two systems, were brought out. The report merits the careful perusal of all those who are in search of information as to the relative merits of the two systems of power distribution.

ON account of the Kansas City convention of the National Electric Light association, the WESTERN ELECTRICIAN is published this week several days earlier than the date which it bears. By the early publication we are enabled to publish before the opening of the convention several matters of interest to all the delegates. According to the latest reports, there is every probability that President Weeks' predictions concerning the meeting will be fulfilled. Those who have agreed to read papers have sent word, with possibly a single exception, that they will be present. The programme which is given elsewhere, shows that many matters of importance to every one interested in electric lighting will be taken up and discussed. Companies are making good their promises to make exhibits. Unless all signs fail, the convention at Kansas City will be one of the most significant in the history of the association.

ONE of the subjects which will doubtless be discussed with considerable vigor at the Kansas City Electric Light Convention, is that of executions by the application of electricity. Probably no topic excited greater attention at the last meeting at Niagara Falls. At that time it was voted that the most earnest efforts should be put forth to secure the repeal of the law which substituted electricity for the halter. A committee was appointed to take charge of the work. Its report will be submitted at the present convention. Since the last meeting the New York electrical execution law has been passed upon by two tribunals, and in each instance its constitutionality has been affirmed. The law is now to be considered by the Court of Appeals. At the last meeting several members were confident in the belief that the law would be declared unconstitutional because it was asserted execution inflicted by electricity would be "cruel and unusual." As two courts have approved the act, the case is certainly not as hopeful now. The unanimity with which the association condemned electrical executions last summer doubtless was instrumental in turning public attention to the objectionable features in the measure, but the organization has a deal of hard work before it if it hopes to secure the repeal of the law. As far as we have noticed no measure looking to the repeal of the law has yet been introduced in the New York legislature.

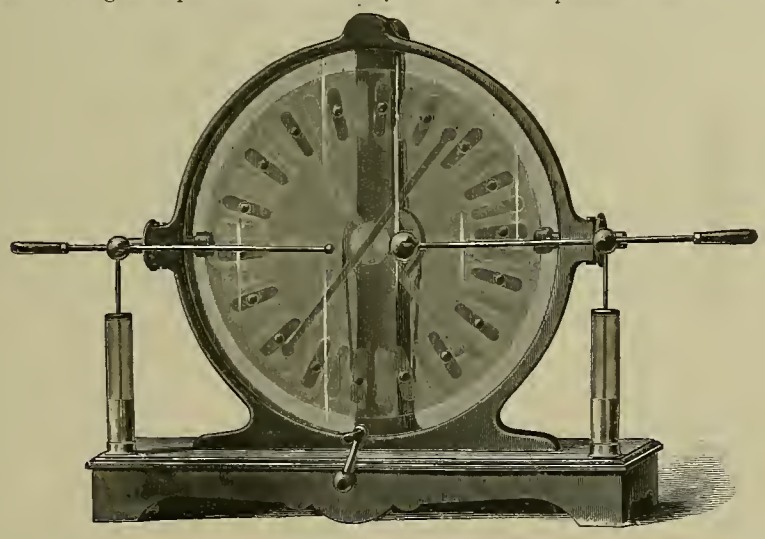
AN article on electric lighting in Chicago by City Electrician Barrett is presented elsewhere in this issue, and contains much that will interest the delegates to the National Electric Light convention at Kansas City. It is a concise history of electric lighting in Chicago, the progress of the underground system and the experience of the city and the commercial companies in operating electric light conductors underground. It is with no little feeling of pride that Prof. Barrett reiterates his statement that the city plant is working satisfactorily, that it is commercially successful and that he has great hopes for the future development of his pet hobby—the city plant. "All electric light wires in this city are underground" he adds, and then follows a brief history of the construction of the conduits in which many practical hints are given as to the construction and maintenance of an underground system. An idea is also conveyed of the magnitude of this industry in Chicago, which has so rapidly developed during the last few years.

IN another column an article by Prof. H. S. Carhart on the "Modification of the Practical Units," is presented. The author takes as his text F. B. Badt's article on "Practical Electrical Units," which appeared in the WESTERN ELECTRICIAN of February 1st. Prof. Carhart first takes exception to the employment of certain symbols in the table which is embodied in the article, and criticises Mr. Badt's definition of a volt as ".926 standard Daniell cell." The main portion of the article, however, is devoted to a consideration of important modifications to which several of the electrical units are subject. Referring to the unit of resistance Prof. Carhart says, "We have in use at least three units of resistance." Following in this line of thought, the author points out that we must consequently "have also as many modifications of all units which are defined or measured by means of the unit of resistance." Prof. Carhart concludes by calling attention to the fact that although the difference between the legal and B. A. unit may seem an indifferent matter, it is too much of an error to be permitted in measurements of any importance.

NEWSPAPER enterprise is commendable when confined to proper limits, but American newspapers are not always satisfied with good natured rivalry or legitimate enterprise. Writers on daily papers in their anxiety to outstrip their competitors, throw off all restraints, resort to sensationalism and indulge in all sorts of wild statements, that a moment's reflection will prove inconsistent. An example of this kind was furnished last week by a Cincinnati newspaper. A careless lineman had received a shock from an electric light wire in that city, lost his balance on the pole he was climbing, and fell to the ground. He was conveyed to an hospital and was soon found to be only slightly injured. Under ordinary circumstances, it would seem that the fact that an accident had occured in which electricity played a part, would be all that could be desired. This would satisfy an ordinary reporter, but the zeal of the Cincinnati press cannot be measured by ordinary standards. A few hours after a two column story with a "scare" head told the trembling residents of Cincinnati in a most exaggerated style the details of the accident. Not satisfied with this, a sketch by a special artist on the spot, was printed purporting to illustrate the unfortunate lineman performing his acrobatic feat. The readers of this paper must have felt inwardly gratified to the accommodating lineman who was so considerate as to wait until the "special artist" was present, before taking the shock.

Wimshurst Machine.

An improved form of the Wimshurst machine is illustrated in the accompanying cut. It consists primarily of two revolving glass disks near together, each having an equal number of tin-foil sectors. These disks are revolved in opposite directions by means of belts and pulleys controlled by a hand crank. The glass disks are inclosed between two stationary glass plates firmly set in the frame, which protect the generators from injury, dust and moisture. The accumulation of charges is rapid, and the spark large and strong. It is well adapted for experimental purposes, multiple gas lighting and in a medical way for the treatment of nervous affections. The machine is handsomely mounted in cherry with brass trimmings. It is placed on the market by the Electrical Supply company of Chicago.



WIMHURST MACHINE.

District Telegraph Box.

To be successful, any business which deals with the general public must be popular, and to be popular, it must be able to meet every requirement of an over-exacting people. To avoid the little annoyances which have attended the use by many of old patterns of district telegraph boxes, a new box shown in the accompanying cut has been placed on the market.

The chief characteristic of this box is a series of push buttons, the name of a "want" being printed on each button. The principle on which it works is that of a divided circuit. It contains the ordinary mechanism of a district telegraph box, having but one commutator wheel, with the notches in its periphery corresponding to the number of the box, and ten notches to correspond with ten different wants. At a given point in the revolution of this commutator wheel which corresponds to the relative position of each push button, the brush may be shunted. Hence, the number of dashes will be sent in, which will correspond to the button which has been pushed down. The box is so constructed that when one button is pushed in, any and all other buttons which may have been pushed in at that time, will be released and return to their normal position.

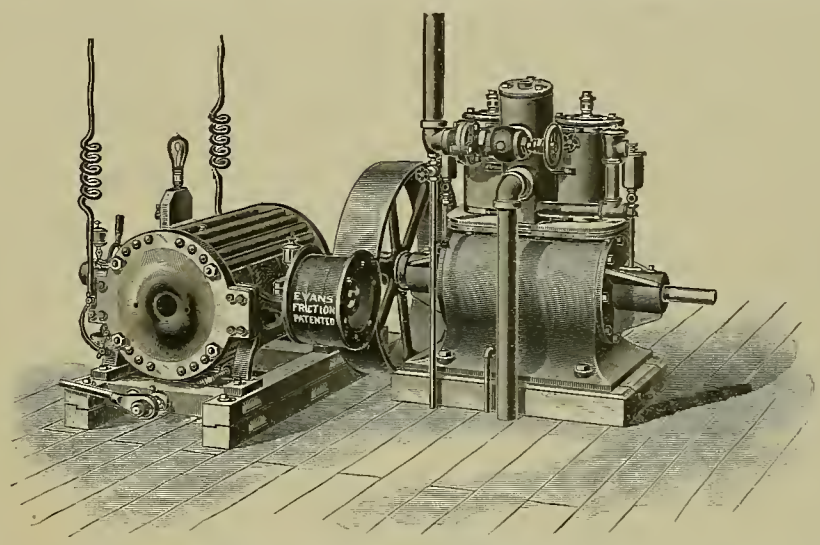
DISTRICT TELEGRAPH BOX.

The return signal on this box is very simple, yet complete. There are two windows, at one of which, will appear when the box is in working order the words "In Order." When the signal has been sent in, the operator at the central station, by pressing a double contact button, breaks the circuit, depriving the line for an instant, of all current. This causes to appear in the other window in every box on that line, the word "Answered," which remains in the window for an instant, and then disappears, the words "In Order" appearing at the other window. This notifies the person who sent the message and all others on that line, that a certain call has been made and has been understood. This makes the box practically non-interfering, as when any box is in use, the indicators in all the other boxes will be moving. The answer back is given in all the other boxes, after which, the box will show the words "In Order." Then any other subscriber who may have been waiting will know that the line is in order, and can be used.

The mechanism which short-circuits the box is simply a small brush attached to each push bar. This brush when the bar is pushed in is held down to such a position that when the proper place on the commutator wheel has reached the brush, it will make a contact that will short-circuit the breaking mechanism. The box is put on the market by the Monitor Electric company, Chicago, Ill.

Evans System of Driving a Dynamo.

The accompanying cut represents an engine driving a dynamo by means of the Evans friction belt. This device was exhibited at the Maritime Fair recently held in Boston by the Evans Friction Cone company. At this fair a 10,000-candle power search lamp was operated and its light was seen for miles about the city. The dynamo which furnished the current was driven from a Westinghouse engine by means of the Evans system. This is not an ordinary frictional device, but differs very materially, both in principle and results, from any other that has before been in use. The power is transmitted from one pulley to another by a series of loose belts, which encircle one pulley, and run between them both. Owing to the use of this loose belt there is brought about an action peculiar to the system, and it is to this feature that its efficiency is due.



EVANS METHOD OF DRIVING A DYNAMO.

In the common frictional devices, the driving and resisting forces are both applied at the line of contact of the two pulleys. In the Evans system, it is explained, the belt cannot be considered a part of the pulley on which it is placed and while the driving forces are applied as before, the resisting force is applied on the inside of the belt. The two forces will constitute a couple of which the thickness of the belt is the moment arm. Since the belt is loose and free to move under the action of these forces, the rotative effect of the couple will incline that part of the belt which is passing between the pulleys in such a manner that the pressure will be transmitted in an oblique direction. With this explanation it can be understood why there is no slip when a load is suddenly applied, for the application of the load is accompanied by a corresponding increase in the driving and resisting

forces. This increase will cause the belt to "trip" with more power and hence diminish the liability to slip.

This action is entirely automatic, and a load may be applied to the full capacity of a belt and easily carried without slip, although when at rest, the pulleys and belts touch so lightly that they can be easily slipped by each other with the hand.

The cut shows at a glance one of the advantages that this system possesses, that is, the small space occupied. In the instance referred to above the test was severe, for since there was but one large light, the full load was necessarily thrown on at once. Moreover, when the carbons of the lamp were in contact, as was frequently the case, the dynamo was short-circuited through the carbons, and the load greatly increased. No slip could be detected.

Besides the saving of room there is also a great saving of belting. Clutch pulleys and belt-holders are dispensed with, for each dynamo in a station may be started or stopped by creating or relieving the pressure on the belt by moving the dynamo on its base in the ordinary manner.

The system is equally well adapted to small and large plants. One or more dynamos may be driven from the fly-wheel of an engine, or they may be arranged on both sides of a long shaft, carrying the driving pulleys. For marine installations, it is stated, less space is required for a plant of a given capacity than would be occupied were the system of direct coupling employed. Although this system has been in use but a comparatively short time it has been applied on installations which are now making for 2,000 horse power.

Modifications of the Practical Electrical Units.

By Prof H. S. Carhart.

The readers of the Western Electrician are indebted to F. B. Badt for his article on "Practical Electrical Units" and particularly for his entertaining biographical sketches of some of the great physicists. The importance of the subject in exact electrical measurements leads me to add a small contribut on in order to explain what must often be a source of perplexity to workers in the electrical field.

Before proceeding to the main topic may I venture to make a correction or two on points in Mr. Badt's table which do not appear to conform exactly to the most general practice? I remark first that the symbol of strength of pole is m and not M as printed. The capital letter is quite universally used, at least in English, to denote magnetic moment, or the product of strength of pole by length of magnet. Again, C is unfortunately used both for strength of current and for capacity. The letter K, which Mr. Badt has used for capacity, is quite generally used to denote "specific inductive capacity." It would be an improvement to adopt the usage of some writers who employ F for capacity.

I should not venture to define a volt as "0.926 standard Danieli cell." It would be necessary to define what standard Daniell is referred to. If zinc sulphate of density 1.4 and copper sulphate of density 1.1 are used, then the electromotive force is 1.072 legal volts, and the volt is about .933 of this standard. If equidense zinc and copper sulphates are used the electromotive force is 1.102, or possibly 1.104 legal volts, and the volt is only .907 of the standard Daniell. The more usual practice is to use solutions of the first pair of densities, in which case the voltage is 1.072.

The unit of self-induction, which is simply a length, the recent Paris Congress agreed to call a "Quadrant" and not a "Secohm," as Professors Ayrton and Perry had proposed.

But I did not set out to make corrections, but to speak of some important modifications to which several of the electrical units are subject. Since we have in use at least three units of resistance (not to mention the Siemens unit) the B. A., the legal and the Rayleigh ohm, we have also as many modifications of all units which are defined or measured by means of the unit of resistance. Independent absolute measurements have been made of the ohm and of the ampere. The volt is then made to depend upon the current and the resistance. Hence, the current being given, the number of units of the electromotive force varies directly as the number of units of resistance; and therefore, the values of these units themselves vary in the same ratio. Hence, as the legal ohm is equal to 1.0114 B. A. units, according to Lord Rayleigh's researches, the legal volt is equal to 1.0114 B. A. volts. The legal ohm being the resistance of a column of mercury one square millimeter in cross section and 106 cm. in length under standard conditions, and the true ohm, according to Lord Rayleigh, being represented by a resistance of a similar column of mercury 106.21 cm. in length, it follows that the Rayleigh ohm is 2 per cent. greater than the legal ohm, and the Rayleigh volt 2 per cent. greater than the legal volt. Lord Rayleigh's form of the Clark standard cell has an e. m. f. of 1.435 Rayleigh volts at 15° C. Hence, it is equal to 1.438 legal volts at the same temperature, since the number of volts in any source of e. m. f. is inversely as the value of the unit employed. This is expressed by saying that the numeric is inversely as the value of the unit. Hence, if a potential difference is expressed in B. A volts it is necessary to divide by 1.0114 in order to reduce the legal volts, since one legal volt equals 1.0114 B. A. volts.

Similar perplexities follow with the numerical value of a current if while B. A. ohms are employed the e. m. f. is expressed in legal volts. Such cases may easily arise in practice.

More perplexing still, perhaps, is the question of the numeric of a capacity. If in the absolute measurement of capacity B. A. units of resistance are employed, it is quite as necessary to take into account the corrections to be applied to the resistances as the correction of the clock in getting the vibration frequency of the tuning fork or circuit breaker used to charge and discharge the condenser. It will be seen from the table of "dimensions" that capacity is inversely as a velocity ($L^{-1}T^{2}$), that is, inversely as a resistance, since a resistance in eleetro-magnetic units is a velocity. Hence, the microfarad is inversely as the ohm employed, and the numeric expressing the capacity in microfarads is directly as the unit of resistance. For instance, a one-third microfarad condenser, measured in terms of B. A. units, equals $\frac{1}{3}$x1.0114, or .3371 microfarad in legal units. Conversely a $\frac{1}{3}$ legal microfarad equals about 0.33 B. A. microfarad. The older condensers were all adjusted in conformity with the B. A. ohm, and hence they are larger than their nominal value when their capacity comes to be expressed in legal units.

Suppose again that we are using Maxwell's method of comparing a coefficient of self-induction with the capacity of a condenser. In this case $L = Q\,R\,C$, in which Q and R are resistances and C is the capacity of the condenser. The resistances varying directly as a length and the capacity varying inversely as a length, it will be seen that the coefficient of self-induction L, varies directly as a length, or has the dimensions of a line. Hence, the numerical value of the coefficient of self-induction of a coil will vary inversely as the unit of resistance employed or directly as the numeric of the resistances. If B. A. units of resistance and capacity are employed, the self-induction will come out 1.0114 times larger than if the resistances and capacity are expressed in legal units.

Whether electrical quantities are expressed in legal or B. A. units, may seem to many quite an indifferent matter; but the difference is over 1 per cent., and no such error as that should be permitted in making electrical measurements of any importance, taking into consideration the precision which modern methods permit.

The Operation of Electric Motors with High Tension Currents.

At the conclusion of Elmer A. Sperry's paper before the Chicago Electric club on "The Operation of Electric Motors with High Tension Currents," which was published in the last number of the Western Electrician, the following discussion took place:

Mr. Degenhardt: I would like to ask Mr. Sperry if, in referring to the breaking down of that insulation on the armature under strain, he meant the exterior circuit or winding of the armature.

Mr. Sperry: No; I merely mentioned that the strain in the constant potential system was constant, and always existed. The strain on the insulation, of course, exists throughout the line, no matter whether the line be a part of the exterior or interior circuit. The strain on the line in the case of the constant current, of course varies according to the amount of energy transmitted. The strain I had reference to is on the exterior circuit.

Mr. Dow: I have made memoranda of two or three points that I would like to inquire about: First, the difference between the brush point in the commutator and that of the greatest difference of potential. That has been referred to by Prof. Silvanus B. Thompson, but it has not been worked out and explained as Mr. Sperry has done. Professor Thompson finds the non-sparking position to be not the position of the highest potential, but a point so far in front that a slight reversed current is generated in the coil coming under the brush. As regards the rotation of brushes, there has been a motor running in Chicago for about eighteen months, and it has worked as well as motors generally. The commutator rotates; it is rotated by a centrifugal governor, and there are a great many others in other parts of the country. It is easier to rotate, having only 8 connections to take care of, and the brushes being rather heavy. As regards compound machines, a compound wound generator of 125-horse power was referred to, and a paper concerning it was read at the last Niagara convention. The characteristic of the machine was very good; as good as that of any compound constant potential machine that I ever saw; the highest potential was about 1,500 volts. The compound winding part of the machine makes the least trouble. The machine is in use to some extent, and will be in use to a greater extent. So that a problem which as lately as within a year has been announced as impossible of solution, the compounding for a constant current generator of over four or five hundred volts, is actually in process of solution, and probably will be completely solved before another twelve months.

Mr Sperry: I am very glad to hear the report of progress, I am sure. The first point the gentleman referred to, however, is not a point I referred to in my paper —the difference in position between the non-sparking points in the commutator, and those of the greatest difference of potential thereon. That point does not exist when the armature and fields are so balanced that the non-sparking point is carried around, as explained. The non-sparking point upon the commutator has more particular reference to any machine where the brushes remain stationary, and where the energy is adjusted by leaving the potential constant and adjusting the amperes. Of course the energy is the product of the pressure into the quantity. Now you can work either way. You can leave the pressure equal and adjust the quantity, because when you come down to the zero quantity, this quantity multiplied with any amount of pressure would be zero; therefore there would be no power at the zero potential, and zero pressure into the greatest quantity you can attain, would also be zero. There would be no power. Take for instance, the Edison machine, which is as well known as any, or better probably, there as the load increases the potential or pressure remaining constant, the amperes or quantity vary and come up. This increases the magnetization of the armature and carries over the point at which the brushes operate best, and are non-sparking. Silvanus Thompson points out that that point is not the point at which the greatest potential can be obtained from the machine. Here we are talking about an entirely different state of facts. We are speaking about rendering a commutator sparkless throughout the entire range, from zero up to its maximum e. m. f. In various works upon the subject this has been pointed out as an impracticability, and people say that it would be a magnificent way to adjust a machine or motor, could it be rendered sparkless. Now the solution is found by means of a certain mathematical function between the force in the armature and in the field. We find that that thing can be done, and we find not only that, but that the range can be broadened out, as I said in the paper, so that there is quite a little range through which it is perfectly non sparking; so that if the current at the point at which it ought to be non-sparking varies either side of the point, still it is sparkless and works perfectly. I have been very much interested in what the Brush motor has done. I think this is the one referred to; the commutator is rotated under the brushes. Of course it is perfectly practical from the fact that the commutator sections and coils upon the armature which have to be coupled with the commutator, are few in number. But in the Gramme armature or Siemens armature, or any armature, in fact, where there are numerous coils, I think you will agree with me that the current is generated under the most favorable circumstances, inasmuch as in that armature alone is the current perfectly uniform and continuous. Where, however, the coils are only few upon the armature, the tendency of the current is to pulsate. Take a medium-sized Brush machine of eight coils. The coils are coupled across, making four coils. Then as they sweep across the field, one of that four is always eliminated from the circuit. Therefore there are only three coils which are doing the entire work. A whole third of the working capacity of the machine is taken out at a time, and another third inserted, making a current very pulsatory, which can be very easily determined by holding a bunch of keys near a magnet, charged with such a current, when you can feel a tremor. Where the current is generated under the most favorable circumstances, and a large number of coils are coupled to the commutator, then the trouble comes in attempting the rotation of the commutator, because all those connections have to be flexible to admit of the movement. Then it becomes much more practicable to rotate the brushes, leaving the commutator stationary. However, I wish to say that in the Comstock Ede the Brush company has several dynamos and large motors in operation under its constant current plan with high potential, and the operation is deemed by that company to be very satisfactory and successful in every particular.

Mr. Dow: I wish to say, as I mentioned in the beginning, the reason that the commutator was rotated in the automatic motor is simply the fact that there are only eight connections to take care of. The rotation of the commu-

tator in an automatic motor in stationary work has been in constant use for some years. On street car and similar motors the brushes are rotated by hand to attain the same end. I did not understand that the displacement of the point of best work from that to maximum potential was the exact equivalent of the observation made by Mr. Sperry, and I see that his observation is largely on the displacement of armature polarity. He says also that the displacement he observes is not the displacement commonly known as resultant magnetism between the armature and fields, but is special and peculiar possibly to a machine with double cores. I will have to take that in; I thought the three observations—the resultant magnetism, the displacement of non-sparking point, and Mr. Sperry's observation —were results of the same cause. Now, I must consider them different.

MR. FERGUSON: Mr. Sperry, in speaking of the comparative complications in constant potential stations and constant current stations, stated that the generators in the constant potential stations were separately excited, as I understood him, and in the constant current stations the generators were self-excited. I think that in the best designed modern stations operated on constant potential, the generators are self-excited, not separately excited. And as far as the complication of the switch-board is concerned, the question of one pressure indicator for every central station, and for every feeder end, does not make a very complicated switch-board. There was another point that I wish to bring out in regard to the self-regulation of a machine. Mr. Sperry stated that constant current machines were self-regulated, whereas constant potential machines were not. Now, there are power stations in this country, operated under considerable loss too on the line, in which I have seen the load change from 20 amperes to 160 amperes, without necessitating any change of the brushes, or without altering the e. m. f. on the line. This was on a 500 volt system; and the engineer in charge told me that he had no trouble whatever in operating these machines. They were compound wound, and are being used to-day in one of the largest railroad systems in the country.

PROF. BADT: I have no doubt that in the transmission of electrical energy from one point to another, at long distances, constant current machines might be used very advantageously. But the example that Mr. Sperry selected in which the distance, I think, was three miles, is hardly a fair basis upon which to judge the adaptability of constant potential, and constant current motors. If we take for instance the transmission of power, as we have it in cities, at longer or shorter distances, and using motors of different sizes (very large and very small motors on the same lines), I think that the constant potential system is preferable to the constant current system, for two reasons. In the first place, if we come down to very small motors, say quarter horse power, or one-eighth horse power, we must send the whole current through that motor. The current, for instance, may be 20 or 30 amperes, or even more. It must be sent through a very small motor. You would necessarily have to have a comparatively large commutator to carry the current, which would make the motor quite expensive. It would hardly give satisfaction as a constant current motor for another reason, which is safety in handling it. Those little motors, of course, are used for domestic purposes mainly, and it would be objectionable to introduce a very high voltage directly into the houses. Now there is another point. Mr. Sperry showed how the amount of copper increases, and of course the cost of copper increases by reducing the e. m. f. Yet, strange to say, it cuts very little figure in the total estimate of cost, at least that is my practical experience. I have been figuring lately on quite a number of power transmission plants, and I find that even with 500 volts, a comparatively low voltage, at a distance of four or five miles, the cost of copper is so small an item of the total cost of the plant, that I would not stop to consider it. Now you take a plant, for instance, for the transmission of 200 or 300 or 400 horse power, the difference of cost of the copper, say between 2,000 volt system, and a 5,000 volt system, would not be sufficient to induce anybody to select one or the other plant. I say it seems very strange at first, and it seemed very strange to me; but after figuring quite a number of examples, I found it to be the case that the cost or expenditure in power transmission plants is in the power itself, whatever it may be, a steam engine, water power and so on, and generators and motors. The line itself is a very small item of the total expense. There is another application of the transmission of power in electric street railways, where the constant potential system is far superior to the constant current system. I know of no electric railway in operation in the United States that is operated by the constant current system. I may be mistaken, but I don't know of any.

MR. DOW: There is one. It is an exceptional one.

PROF. BADT: There are certainly a good many railways in operation in the United States, and so far as I know they all operate on the constant potential system for obvious reasons. The main reason is that it would be, in my opinion, quite a hard thing to transmit power to the cars on a series system. And in the second place, if you employ a series system, you must have overhead lines for both outgoing and returning circuits, as it would be objectionable to have high potential returned by the rail.

MR. SPERRY: You couldn't do it by the rail and have more than one car on the line.

PROF. BADT: Even if you could, it would not be advisable. So I think, after all, that the application on a large scale, for great power transmission plants, the constant potential will hold its sway for a long time yet. The two main reasons are, safety in low potential, and I think that constant potential plants for transmission of power can be operated easier than constant current plants.

MR. SPERRY: I do not wish to prolong this discussion, but I am very much interested in constant current machines. Mr. Ferguson said he understood me to say that in a constant potential dynamo an exciter was necessary; that is exactly what I said. With a constant current dynamo of 3,000 volts or 1,500 volts, or 1,000 volts even, undoubtedly an exciter is cheaper than winding the field with extremely small wire. You understand you have to have wire extremely small when you get up to as high potentials as those named. For instance, in the transmission that I have referred to, you have to have 5,000 ohms in the field, and you must have a No. 22 wire.

PROF. BADT: I have seen machines of the United States company of 3,200 volts, and they used very fine wire, a good many miles on the field, but I think not as fine as that.

MR. SPERRY: In this case there were 62 miles of wire on the field. As I said, one reason why an exciter is preferable when you get up to high voltages, is that the wire is so extremely fine and hard to handle that it would be liable to get out of order. In the case of the high potential again, the ratio of cotton to copper or the ratio of insulation to copper is great—this requires an immense space. You have to have a large machine as compared with the series machine. It costs more for copper; it costs more for iron; it costs more to build a machine, because it has to be a larger machine. The ground I took with regard to the exciter was not that the 220 volt machines that you have here, or 110 volt machines would necessitate the use of the exciter; it is merely because with the high potential, in the case I cited here in the paper, an exciter would be far preferable in rough and inexperienced hands, or in trying to maintain it at no very considerable cost. In regard to the switch board, take the ordinary high potential machine, constant current, the dynamo is located in the station, and the wires are taken from the two binding posts of the dynamo, one to a small ammeter on the wall, and both out of the station; no switch-boards, no rheostat for the control of the fields, as in the case of an ordinary shunt wound dynamo, or even in the case of a compound or over-compounded machine, as they are now made. We have to have an adjustment even on that; and as I say, the switch-board arrangements are similar. But with constant current there is no switch-board necessary. The wires merely go from the dynamo out on to the main line to the motor, or whatever translating device may be used. Whereas in the constant potential there must be a rheostat, and there should be also an ammeter, and the high potential voltmeter is a very expensive item, because it must be made to withstand the extreme potential, of course. With regard to the point that Professor Badt brings forward, that with a constant current, small motors cannot be operated—he meant that it was impracticable, perhaps—there are many in place to-day, quarter horse power, in operation very satisfactorily with ten amperes.

PROF. BADT: If you transmit a couple hundred horse power you will have more than ten amperes in your line.

MR. SPERRY: I have taken here the transmission of power from one point to another; I have covered that point in my paper by saying that undoubtedly for widespread distribution a constant potential system is more practical at the present time, but in the near future I see no reason why it should not give place to the constant current

PROF. BADT: If you want to transmit say 200 horse power?

MR. SPERRY: Yes.

PROF. BADT: In such a case it is almost impossible to employ little motors. I do not speak of arc light circuits, but of transmitting a couple of hundred horse power, where the power is distributed all along the line. That I say is impossible.

MR. SPERRY: I do not look upon it as impossible.

PROF. BADT: Take a one-eighth horse power motor, with 60 amperes passing through it?

MR. SPERRY: I hold that in a distribution of that kind where a constant current will be employed, there should be no motor used as low as one-eighth horse power.

PROF. BADT: That shows that small motors cannot be used in such transmission.

MR. SPERRY: In the case of transmitting power from one point to another there is no comparison in the practicability all around, between the constant current and constant potential. I can show you by actual figures as to the cost of the apparatus, as to the cost of the installation of the line, including the construction, as to the cost of the motor, that there are no advantages in the comparison. I do not agree with you that, as compared with the electrical out-put, or as compared with the money invested in the total plant that the particular portion of the money invested in the line is small, especially at 500 volts named by you. That item is quite large as compared with the amount of money invested in the electrical part of the plant. It makes a great deal of difference whether it is $7,200 or $800.

PROF. BADT: Not if the whole station was to cost $200,000.

MR. SPERRY: In that case the same ratio would hold, but you would be dealing with far larger quantities. I say that in a station costing $200,000 for the transmission of energy from one point to another, the constant current is the only thing that ever ought to be employed for economy; that is the ground I take, and I can maintain it with figures.

MR. FERGUSON: I would like to say a word about regulation. Mr. Sperry said in the constant potential machine there was something on the back of it that you had to regulate in an over-compounded machine. I think Mr. Sperry will remember that in any constant current machine, if he has a regulator on it, he has to set it when he first starts his machine. In an over-compounded machine, if you set it once, it holds good forever. You don't have to change it at all. There are over-compounded machines running in this country, which require no hand regulation or changing of the brushes under changes of load.

MR. SPERRY: Allow me to say one thing about over compounded machines; there is one trouble about them. An over-compounded machine is supposed to hold the potential constant, at the ends or at the center of distribution. Now then, we start and take off various transmitting devices along down the line. That is often done in transmission, especially in mining processes where you distribute, for instance, 80 to 150 horse-power in a mine. You have the mains that go down the shaft and out the main entry, clear to the center of distribution, and from that point distributing to the main room and main entries where the work is in operation. It is very desirable to have light, and perhaps a motor or two in use as you go down. The trouble with using an over-compound motor is that where it is set for holding the potential constant at the center of distribution, only, the potential is not constant anywhere else. Just the moment you increase your power in amperage on the machine, the speed will naturally fall. We have tried both. We have put them under the same conditions, and I fail to see where any particular practical advantage arises from the over-compounded machine under those conditions. Of course, it is a beautiful thing in figures. But as it operates practically, it does not seem to have any particular advantage over and above an ordinary shunt machine. And one more word upon that line. I want to say that the ordinary shunt machine, when built with a good high armature velocity, and with the low resistance in the armature, very few turns compared with the electromotive force, that it can be so constructed that it can be made almost perfectly automatic.

For the successful operation of machines it is essential that all complexities should be done away with, when they are to be put out in the hands of the ordinary engineer to be operated. As soon as your machine is set up the letters commence to come in, "What is this for?" "How do you adjust this?" and "How do you adjust that?" All those things should be avoided.

F. L. PERRY: I would like to ask one question in regard to constant potential motors, which was suggested by Prof. Badt's remarks in regard to the relative advantages of the constant current system and the constant potential system. Isn't there a decided advantage in the constant potential motor on account of its ability to handle a load in excess of its rated power? Now, the point I refer to is this: I remember in St. Paul at one time I installed a three-horse arc motor for elevator work, and that motor at times had to take a load in excess of three horse-power. Of course, it failed; yet the company furnished a three horse-power constant potential motor that did the work. Now, the consumer couldn't understand this, and thought it was very peculiar that he couldn't do with a three horse-power constant current motor what could be done with a three horse-power constant potential motor. Of course, the only answer to that question is the three horse-power constant current motor was sometimes overloaded in elevator service, and the other motor was capable at times of furnishing more than three horse-power. Isn't that a point in favor of a constant potential motor?

MR. SPERRY: I will answer that that is one advantage. It is the *one* advantage that the constant motor has, that you can load it up to almost 50 per cent. over its normal capacity for a short time. Of course, it commences to heat rapidly, and the extra loads must be shortly taken off, or the motor will burn up. But the constant current motor to meet those extra requirements will have to be built larger. Even then with high potential it is not nearly as large a machine as the constant potential motor.

MR. FERGUSON: From a commercial standpoint it is a well known fact that all the motor companies, if they possibly can, will set up a constant potential motor. Companies selling both will sell a constant potential motor every time in preference to a constant current motor. It is well known in this city that the companies are taking out the constant current motors and installing constant potential motors

I would like to say that it seems to me that the question of regulation is simply coming down to a question of wiring. Mr. Sperry speaks of an over-compounded machine keeping the pressure at the center of distribution the same as at the dynamo. That is just the point. It does. If your wiring system is properly designed, your pressure throughout the entire system will be constant, and the potential in the center of distribution constant. It is simply a question of wiring, construction and design.

As far as the complexity of the machine is concerned, I do not understand why an over-compounded machine is any more complex than a shunt machine, after it is once set by the expert. The expert sets the rheostat on the back of the machine, or wherever it may be, and after that is once set, you don't have to do anything with the machine at all. It takes care of itself. There is no sparking, and you don't have to move your field resistance at all. The engineer doesn't have to do anything at all to the machine except to look after the bearings and keep the brushes clean.

MR. SPERRY: The trouble with the compound machine is that after you put it on the engine, when you load up the engine, the speed comes down. If the engine is regulated by a centrifugal governor of any kind, it does not matter how it is worked, so long as it is worked by centrifugal force, as soon as the load increases steam must be let on in some way, which means that the governor balls must come in, and the centripetal force must be allowed to act. That means that there must be a loss of speed somewhere. Now, of course, that loss of speed affects the dynamo, and that means that the dynamo is not run with a constant speed. The moment your load comes up, your speed is crippled to a certain extent. Where the method of transmission of power to your dynamo is by means of the belt, when the load is increased, the belt will commence to slip. The machine works beautifully in theory and in mathematics, but when you commence to calculate the trouble and to see the practical conditions under which it must operate, you will find, as I have done, that it does not work much better than an ordinary shunt machine; it costs more to make it; it is more complex. It has been said in regard to the central point of distribution, if the wiring is done right, as it ought to be done, the machine will work satisfactorily. Of course, you notice that in the instance that I have given here, the mains come down the shaft and go along the entries, and have to go out to the central point of distribution, many times a long distance. Now, you would have to start a long wire away out there and bring it back, when you could as well utilize the energy

on the main wire. The first thing the mining engineer would say would be, "Why do you take that wire from the distant point and bring it clear back to this point again?' In the ordinary distribution the best way is to use large mains with little drop, and to use them for all purposes as they pull along.

F. L. PERRY: I notice that Mr. Sperry said in his paper that he thought in the future the centrifugal governing machine would be brought to the same state of perfection, so far as governing is concerned, as the shunt-wound or compound-wound motor. It seems to me that the remark he makes about our best steam engine would apply as well to the best constant current motors.

MR. SPERRY: I spoke of the average engine.

MR. FERGUSON: I do not think the mechanical engineers would agree with Mr. Sperry in his remarks; any good engine will give a regulation within two per cent., and with that regulation you ought to get a machine that will operate well on constant potential. The question of wiring for mining, it seems to me, is a very extreme case. The mining business is not the only business in which we use the transmission of power by electricity.

There are instances in this country, in Boston especially, to-day, where there are over-compound generators that run at 500 volts, and keep the pressure at 500 volts without changing the brushes at all.

MR. BLISS: I did not intend to express an opinion as to which is the better current to use for motors, whether the constant potential or constant current but I am interested in a small electric street railway which is operated under rather aggravating circumstances. For instance, there is a rise in grade of 300 feet in two miles. It is a fact that the person who has charge of the dynamo room says that he gets a great deal less sparking if he stands right by the generator and moves the brushes as the load comes on the dynamo. Now it is still further a fact that I have stood by the voltmeter, and have tried the voltage on the line repeatedly, and sometimes for long periods of time, and found a very decided change in the potential on that wire. Now I suppose to a certain extent that may be due to some slight variation in the engine, as the load comes on the machine, but I don't think that is enough to account for the variation in the voltage on the line.

And furthermore, it is a fact that we have had quite a number of burn-outs in the motors themselves. Now the point that Mr. Sperry raises in regard to two motors worked upon the same car, or connected together, is a very important one in electric street railways at the present time.

PROF. BADT: In a street railway system, if we had a constant current motor, and the car was overloaded, and was trying to climb up a grade, and the motor was capable of developing five-horse power only, the car will not go up. In the case of the constant potential motor the motor will do whatever is necessary, but of course if it has to do more than the work it is built for very often, the armature will burn up. The difficulty with the majority of electric street railways has been that the motors employed were too small. A car, as a general rule, on a level track, can be run with three or four horse power easily, but the moment it is heavily loaded and it has to go up a grade or around a sharp curve, it will take ten or twelve or fifteen horse power for the fraction of a minute, or even for a few minutes. A very simple rule is to make your motors large enough, and then you won't be burning up armatures. In all the railways that I have seen constructed during the last six or seven months, they have put in motors which were called five-horse power motors, while in fact the motor would easily do fifteen horse power work if required. So I do not think that there is any advantage in the constant current motor over the constant potential motor at all. It simply shows that the constant potential motor will do whatever it is required to do. If it is overloaded of course it will heat and burn up. I would rather it would do that than simply to let the car stand in the street on account of a little incline.

MR. BLISS: I don't want any misunderstanding as to the capacity of the motors on these cars, because they are twelve or fifteen-horse power motors.

MR DOW: I want to spring a bunch of heresies and then sit down. The first heresy is, that over-compounded machines, not for power, but particularly for incandescent lighting, have been in use for some time. They don't have any rheostat on the backs, not even a switch sometimes. They are put into the hands of planing-mill engineers and wood-choppers, and the directions are simply to keep them running steadily, and rock the brush backward and forward, so that they don t spark. Those machines work. These over-compounded generators have been a great success; no trouble, no repairs, very little trouble in operating. The second heresy is, that series railways are in operation. I thought I heard Professor Badt say that there was no street railway working under normal conditions of heavy city work. I want to say there is such a railway in operation, with a series system, and it is not complicated, and the difficulties arising in connection with it are not such as to be discouraging at all. As far as commercial results are concerned, it is a great success. There are several others in operation, but I will not refer to them at present. I think from what I have seen of street cars operated by the series system that that system has a great future before it. It can be worked as an automatic block system, so there is no possibility of a collision, and so operated will be specially useful in mine work and work of that kind.

The third heresy is, that the question of change of lead, not only in constant potential motors and generators, but in constant current motors and generators, is a matter to be got over by proper proportions. There are constant current motors running up to medium size—say ten to fifteen-horse power—that don't spark, and don't require an adjustment of the brushes. A constant current compound wound generator with constant lead is not yet on the market. I don't know when it is going to be put on the market, but it is going to get there. I have no doubt.

MR. FISH: It has been stated here that a company in Chicago has been taking out constant current motors and putting in constant potential motors I represent the largest company in this city, and I wish to state that the main reason for that has been that the effort has been made to run these motors with an ordinary lighting generator. That generator is satisfactory as far as the automatic regulation for lamps is concerned, but it is too slow for a motor. At present though, we have a motor generator of the capacity of 80-horse power, and we can run 100 lights on it, so that I know I am safe in saying that it has 80-horse power capacity. With that generator in operation I feel safe in saying that there will be no more constant current motors taken off of that circuit, and constant potential motors substituted.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 8 —Residents of this city are anxiously awaiting the return of the electric lights in all the streets where the subways are completed. The electric lighting companies are availing themselves as rapidly as possible of such subways as are ready for use; but it may be two months yet before all the lights even in the streets where there are subways will shine. At present, the only public electric lights are a few on Sixth avenue, near Fourteenth street, and those in Harlem under the control of the Manhattan company. This company was fortunate enough to have availed itself of the completed subway in 125th street early and when the General Term of the Supreme Court dissolved Judge Andrews' injunction, Commissioner Gilroy's raiders were unable to interfere with the continuance of the electric lights in that street and consequently there has been no cessation of the perfect lighting of 125th street.

The United Electric Light & Power company promises a speedy return of the electric light in the down town districts and the high tension alternating current will be maintained underground, while the converter system will be used for all incandescent lighting as well as a new converting device for arc lighting.

It is admitted that electric lighting for the streets has become a necessity, and the entire city will eventually have the benefit of such illumination, but for many months only Broadway, the Bowery, Third avenue, Houston, Fourteenth, Twenty-third, Twenty-ninth, Forty-second, and Fifty-ninth streets and Sixth avenue, from Fourteenth to Fifty-ninth streets can be lighted. In the entire remaining streets subways will have to be built, as all attempts for overhead wires for lighting has been abandoned.

A very important decision affecting street railroads was handed down by the State Board of Railroad Commissioners, in regard to the accident on the cable road which caused the death of Bernard Sieber on January 25. The board found that the Third avenue road which runs a cable on 125th street had neglected to equip its cars with life guards as required by the board in April, 1887.

Geo. Westinghouse, Jr., president, and C. H. Jackson, vice-president of the Standard Car Heating & Ventilating company of Pittsburgh, have become directors and stockholders in the Consolidated Car Heating company of Albany. The interests of the two companies are thus consolidated and the field of operations has become greatly enlarged. The addition of a number of valuable patents of improved devices for heating, ventilating and electric lighting of railroad cars is insured and an automatic regulation which will obviate sudden changes of temperature in steam heated cars. This device is an attachment to the air-brake cylinder, and is being tested upon the Pennsylvania railroad.

Seth Low was inaugrated president of Columbia College Monday, at the Metropolitan Opera House, amid the cheers of the assembled students and promoters of the great institution of learning.

Invitations have been issued by Edward H. Johnson, announcing an exhibition test of the New Safety Conduit system. The exhibition will be held at the factory of the Bergman Electric & Gas Fixture company, and a very interesting time is expected.

Dr. Otto A. Moses, the well-known electrical expert, was elected chairman of the stockholders meeting of the suspended Lenox Hill bank, the affairs of which are now being closed up.

It will be remembered that at the last meeting of the Board of Electrical Control, Mayor Grant announced his intention of submitting the proposition of the Subway company in the matter of sub-letting contracts to the corporation counsel. This was done early in the week, and a conference was held, at which Edward Lauterbach, for the Consolidated Telegraph & Electrical Subway company; Wheeler H. Peckham, for the Standard Subway company; Paul D. Cravath, for the Westinghouse company; Elihu Root, De Lancey Nicoll, ex-Judge Kelly, ex-Senator Grady and several other attorneys, for the Thomson-Houston interests, and also a number of electric light officials were on hand. Mr. Lauterbach said that in obedience to public demand a great amount of work would have to be done in subway building the coming summer, and his company did not feel capable of undertaking to do it all satisfactorily, and hence the proposition under consideration. The Standard company, he said, was not only to build future subways, but also to take, 'at a fair consideration," the subways already built. The Subway company claimed that the Board of Electrical Control had the power to make another contract with the new company, although it held a different opinion when Mayor Grant wanted to give the competing companies a chance a few months ago. Mr. Root, in behalf of the Thomson-Houston company, insisted that great injury to other electric light companies might result from one electric light company controlling the subways, as they may be crowded out of business by excessive tolls. He said it was the duty of the Board of Electrical Control to see that the Standard company, if given the contract, carries out its own proposition to reduce tolls for ducts. Corporation Counsel Clark said the question before him was simply as to the city's right to make a second contract and the form of the contract was a matter for future consideration. Mr. Peckham said that when it came to making the contract the Standard company was prepared to accept such conditions as would guarantee all electric light companies equal rights. The question was, could the board make a second contract? If it could, there was nothing to prevent any of the electric light companies competing for the work.

W. H. T.

Omaha, Neb.

OMAHA, Feb. 7.—This city can present to-day an excellent illustration of the enterprise characteristic of the West in its electric lighting companies. Under its new organization the Thomson-Houston Electric Light company has become one of the strongest corporations in the city. It has a capital stock of $600,000, and furnishes steady employment to thirty men. In order to keep pace with this growing city, the Thomson-Houston company is now engaged in constructing new works of a size and capacity sufficient for the wants of Omaha for years to come. The plant is located at the foot of Jones street on the Burlington and Missouri River railway, and it is expected that it will soon be ready for occupancy. This large building is to be three stories in height, 118x135 feet in dimensions, constructed of brick and stone, and supplied with every modern mechanical and electrical convenience. There will be a battery of steam boilers of a combined capacity of 2,400-horse power. The boilers will be supplied with automatic stokers and other labor saving inventions. Three ponderous engines will be set up, two of 500-horse power each, and one of 200-horse power. Fourteen new dynamos have been ordered. They will be able to furnish power to small manufacturers having light machinery to run, such as sewing machines, small printing presses, machine shops, etc. Omaha's city council has entered into a contract with the New Omaha Thomson-Houston Electric Light company to light the city by electricity. On Feb. 15 the contract goes into force, and over 100 arc lights must be in operation. The company expects to be in readiness to comply with the contract. To construct the circuits for street lighting $50,000 has been expended, forty men have been busily employed and seven miles of wire used. The company is backed by the strongest capitalist in the city.

O.

THE ELECTRIC LIGHT.

The Hyde Park Electric Light & Power company at Chicago, has filed a certificate of decrease of capital stock from $500,000 to $100,000.

The underground franchises granted P. H. Canavan, George L. Ladd and their associates in 1881, has been declared forfeited by the supervisors of San Francisco.

At a town meeting in Mexico, N. Y., recently, a five years' contract was made with the local lighting company for 25 arc lamps. The company is using the Schuyler system.

Sacramento, Cal., is at last to have an electric light plant. A contract for alternating current apparatus for 1,500 lights has been given to the Westinghouse Electric company.

The Pacific Electrical Storage company recently furnished the fire department of San Francisco an electrical lantern for use in cases where ordinary lamps would be of no value.

The Bear Electric company has been incorporated at Chicago, to furnish electric lights and power; capital stock, $3,000,000; incorporators, S. J. M. Bear, N. H. Hanchett, and A. P. Willoughby.

The city of Dowagiac, Mich., is congratulating itself on the fact that it has an excellent electric lighting plant which it terms first class in every respect. It is the Westinghouse system and is used for street lighting as well as the illumination of stores and residences. The city has

100 32-candle power lamps distributed at street intersections. James Heddon, mayor of the city, writes that the plant is giving satisfaction and adds: "We think we have the best lighted resident streets of any city in the country."

The Westinghouse Electric company received orders for arc lighting apparatus from the following places during January: Allegheny County Light company, Pittsburg, Pa., 125; Salem, O., 20; Oldtown, Me., 35; Uxbridge, Mass., 20; Boston, Mass., 653; New York, N. Y., 125.

The Edison Electric Light company of San Francisco has petitioned for a franchise to construct underground conductors for electric wires in that city for a term of twenty-five years. A representative of the Edison company has petitioned the Oakland, Cal., trustees for a fifty years' franchise.

The Metropolitan Electric Supply company, limited, of London, Eng., is about to add a large increase to its electric light plant in the English metropolis. The Westinghouse Electric company was awarded the contract a few days ago for alternating current apparatus of a capacity of 15,000 lights.

The Pittsburg, Kan., Gas Light & Coke company's electric light plant, installed by J. A. Bendure of Ottawa, Kan., consisting of two 25-light Waterhouse arc dynamos, and a 750-light alternating machine of the Westinghouse system, was started Feb. 1st. The company has a large city contract for lighting the streets with arc lights.

It appears that the question of cheap light for public buildings and streets will prove an important matter in the municipal elections at Milwaukee. It is proposed to establish a city electric light plant and the advocates of this project suggest that only such candidates for city councilmen as are known to favor the plan receive their support.

The city electric light plant at St. Joseph, Mo., which was installed by the Excelsior Electric Light company, has just passed through a satisfactory trial, and has been accepted by the city. City officials and electrical experts employed by the city council have subjected the plant to a severe test, and have reported their findings. These reports are highly satisfactory to the city and complimentary to the Excelsior company. The plant consists of seven 30-light machines and an additional dynamo will be installed at an early day. The residents of the city are anxious to have the plant increased, and the lights placed in all the streets of the city.

Mansfield, Ohio, is contemplating the establishment of an electric light plant to be owned and operated by the city for lighting the streets and public buildings, the city having been unable to make a satisfactory contract with the local gas and electric light company. Authority will be asked from the state legislature for the issue of bonds sufficient to meet the expense. The advocates of the plant claim that it can not be built and equipped for less than $50,000, and it is probable that a vigorous fight and protest will be made against the bill asking authority for the issue of the bonds, whatever the amount.

Probably the only Chinaman in pursuit of electrical knowledge in this country is Bert C. Lee of Canton, China, who has been employed at the works of the Westinghouse Electric company, Pittsburg, Pa., for several weeks. Mr. Lee was sent to America at the expense of the Chinese capitalists who have contracted with the Pittsburg firm for several large electric light plants in the Flowery kingdom. Mr. Lee is here to study the Westinghouse alternating current system of electric lighting, and make himself sufficiently acquainted with the apparatus to take charge of the central stations in China. Mr. Lee is a very intelligent looking young man, and his English is also superior.

It is generally agreed on the other side of the Atlantic that electric lighting conductors of every kind must eventually be placed underground, says the London *Electrician;* but nobody at present seems to see how it is to be done, for none of the experiments tried so far on a considerable scale have proved wholly satisfactory. In the meantime the opinion is gaining ground that it would be comparatively easy to devise an overhead, or above-ground system that would be unexceptionable both to eyes and nerves; and we can see no reason why such should not be allowed in many instances. As to their unsightliness they should be kept out of view as much as possible by running them over housetops, or, as in many cases would be practicable, along the sides of the buildings on suitable brackets, crossing the thoroughfares only at right angles and at suitable heights. Warned of the objections that are likely to be raised, the companies must respect, and not recklessly provoke them, as some of the telephone companies have done. The safety of the wires is a problem of still easier solution. Conscientiously done, the work need give no grounds for apprehension either from risk of fire, breakage on to the streets, or contact with human beings. The experience of the London Electric Supply corporation is sufficient proof of this, although their system does not in all respects come up to our ideal. Only one serious accident has occurred in connection with this company's wires, and that by no means conclusively traceable to the electric current. We are rather more sanguine than our American friends about the success of the underground experiments which are now about to be tried in London; but it is evident that only in large towns can underground systems be constructed at all. In the small towns, which are just now loudest in their denunciation of the overhead system, they will have to accept that system or none; for it would never pay to put down an underground system to supply a few hundred lights. There are ways of doing the overhead work, however, that would be at once inoffensive, inexpensive, and safe; and electric lighting undertakers will be wise to take the utmost pains to conciliate public opinion on these points.

THE ELECTRIC MOTOR.

Omaha, Neb., has 32 miles of electric railroad.

The city council of Rochester, N. Y., has finished its investigation of the several systems of street car propulsion, and the committee has prepared a contract acceptable to the street car company, providing for the immediate introduction of the overhead trolley system throughout the city. In recommending the adoption of this contract the council committee says: 'That electricity as a motive power for the propulsion of street cars has come and come to stay, is a fact which no well informed person will deny." The press and people of Rochester have co-operated most heartily with the council and the street car company, and the assistance thus given has been very valuable to the project.

The electric railroad at Laredo, Tex., was formally opened last week with due rejoicing. An elaborate banquet was served, and all the prominent men of that section were present. Among those who responded to toasts were: United States Consul General W. P. Sutton, Mexican Consul Rafael Varros, Mayor E. A. Atlee, Laredo, Tex.; Santiago Belden, Mayor of New Laredo, Mexico, Col. Albert T. Brackett, commander Fort McIntosh; Col. E. H. Roper, Prof. G. J. Buck, C. F. Yaeger, Hon. Thos. W. Dodd, A. W. Gifford, Col. C. F. Drake of Fort Scott, Kan.; Wm. T. Mottram, representing the Sprague company. The Laredo electric railway, which is operated by the Sprague overhead system, has been in practical operation since December 6, and has given entire satisfaction. It is five miles in length, extending from the Grand Union Depot to Hotel Hamilton, on Jarvis Plaza, now the business center of the city, and thence to the artesian well on the heights. From Jarvis Plaza the road runs also to the International foot passenger and tramway bridge over the Rio Grande, connecting the two Laredos, the distance between the business centers of the two towns being less than three-fourths of a mile, and will be immediately extended across the bridge to the Mexican custom house, where the change is now being made to electrical equipment. In the business portion of the city the supports of the overhead wires are of iron, painted black, and are very handsome and substantial. The power house, 50x150 feet, is of brick with iron truss roof and fire proof. The boilers and engine were purchased of the Pond Engineering company, St. Louis; the engine, manufactured by Armington & Sims, being of 110 horse-power. The Edison dynamo is belted directly to the engine. At present there are in operation six cars, 24 feet in length, each equipped with a fifteen horse power motor which is under such perfect control that the car may be stopped within 12 feet when traveling at a speed of six miles per hour, with a load of fifty people. The cars were manufactured by the J. G. Brill Car company, Philadelphia, and each is lighted by five twenty-candle power lamps. Ten new coaches have been ordered including a palace car for private parties. Two large coaches are now on the way from the factory, each capable of seating eighty people. These additional cars are rendered necessary by the rapidly increasing business, the capacity of the cars now in use being often insufficient to carry the passengers, and so crowded that it is frequently impossible to collect all the fares.

THE TELEGRAPH.

The following note has been received from .F. Catlin, manager of the National "Fast Telegraphing Tournament:" "The coming tournament will be held in April. Money for prizes is being raised by subscription on the part of the press associations, manufacturers of instruments and similar interests. The tournament will be held in a convenient hall, and several hundred dollars will be offered in six prizes."

The Western Union Telegraph company was sued recently by R. W. Crawford of Houston, Tex., for $10,000 actual damages, and $20,000 exemplary damages, and a jury awarded $350 for plaintiff. The cause of action was the non-delivery of a telegram announcing the death of plaintiff's sister and the fact that the body had been sent to plaintiff's house for burial. The first intimation the plaintiff received of his sister's death was when the body was brought to his house.

Miscellaneous Notes.

At the annual exhibition of the products of ingenuity and mechanical skill of the pupils of the Cleveland, O., manual training school last week, a number of dynamos, motors, induction coils and electro-magnets were displayed. The progress of the boys was highly applauded by all who examined the products of their labor.

The supervisors of San Francisco are considering a petition recently filed by the San Francisco Underground Conduit & Electric Light, Telegraph & Telephone company for permission to construct and operate for twenty-five years conduits and pipes, wires, cables, etc., in the public streets for the transmission of messages, sounds and signals, and for the production of power, heat and light by the aid of electricity.

Advices from Minneapolis announce that E. C. Hughes has lately been experimenting with the heating capacity of electricity, and has demonstrated that almost any degree can be produced with comparative ease. He has gotten up an oven for baking and for testing gluten. The gluten is placed in a cylindrical glass case, about an inch in diameter, which in turn is placed in the oven, the latter also being in cylindrical form, and under a heat of about 500 degrees the gluten is baked in about twelve minutes.

The London *Electrical Engineer* is responsible for the following: "The latest and most unique invention is a machine for buttering bread. It is used in connection with a great patent bread-cutter, and is intended for use in prisons, workhouses, and other reformatory institutions. There is a cylindrical shaped brush which is fed with butter, and lays a thin layer on the bread as it comes from the cutter. The machine can be worked by hand, steam, or electricity, and has a capacity of cutting and buttering 750 loaves of bread an hour. The saving of butter and of bread and the decrease in the quantity of crumbs is said to be very large."

Omaha, Neb., has a fourteen-year-old amateur electrician who has already turned his attention to introducing electrical novelties to his friends and neighbors. His latest device was introduced while he was engaged in coasting, and evidently attracted considerable attention to his "traveler," as he calls his sled. He writes: "On my traveler I have a 4-inch skeleton bell to ring from the rear and front both. I have four flat dry cells and have them in a small box in front of the back sled. It is used to clear the track when we are going down the hill. It is great fun to see the people look at the bell when it rings; they cannot see the box because it is so small."

The following is from the London *Electrical Review*: "In the WESTERN ELECTRICIAN of the 11th inst., there appears a drawing and description of a new form of grid, or secondary battery plate, which is said to be the invention of H. G. Osburn of Chicago. At first sight it would appear as though the plate were composed of two grids, so placed in relation to each other that the openings in one coincide with the points of intersection of the ribs in the other. Instead, however, of there being two plates, the grid is cast in one piece. Some time during last year J. S. Sellon showed us some plates of his own identical in every detail with that of Mr. Osburn. Which of these gentlemen claims priority of invention?"

A dispatch from Philadelphia announces that a syndicate has been formed in that city in which it is said English capital to the amount of $50,000,000, and even more American capital is engaged. One of the objects of this trust is to purchase electrical patents. The syndicate is working under the name of the National Construction company. It has asked the Canadian parliament for power to acquire by construction, purchase, lease, or otherwise any lands, railways, mines, tramways, gas, and electric plants and works, docks and warehouses. The petition as presented to the Canadian parliament by Mr. Mills of Annapolis, bears the signature of E. F. Clements, general manager of the Yarmouth (N. S.) Electric Light company; C. F. Frazer of Halifax; John White of Dartmouth, N. S.; the Hon. J. E. Addicks of Philadelphia; the Hon. L. M. Child of Boston; F. L. Clements of Yarmouth, and P. W. French of Boston, secretary of the National Tube works.

An interesting experiment is being made in Paris. Seven cabs have been furnished with seven different and rival methods of ascertaining the length of ten different fares. The systems will be on probation for a month, and at the end of that time one will be selected for universal adoption. They vary but little in design and the system which will work with the greatest accuracy and at the lowest cost will be adopted. As you enter the vehicle a dial faces you which registers your liabilities. The very act of entering sets free an electric current and the dial announces that you already owe half a franc for taking the cab. Then when you start on your journey the dial shows every kilometer you go, with a charge of twenty-five cents for each. The rotations of the wheel supply the means of ascertaining the distance, which is of course the same whether the speed is great or little. At any moment the hirer can tell exactly how many miles he has gone and his exact fare, and the cabman who is thus paid by mileage with a fixed entrance finds his own interest in driving fast and getting as many jobs as possible.

Personal Mention.

George S. Searing of the New Haven Clock company, New York, was in Chicago last week.

F. W. Roeblings, treasurer of the John A. Roeblings & Sons company of Trenton, N. J., was in Chicago last week and visited the Electric club as a guest of Mr. Geo. C. Bailey, the Chicago manager of the company.

Business Mention.

The Gate City Electric company was established in Kansas City in August, 1889. J. W. Mason is the manager. The company deals in electric light, telephone, telegraph and electric railway supplies. It makes a specialty of okonite. It has been doing a good business ever since its establishment and Manager Mason says prospects are bright. A recent contract secured by this company was that of furnishing 40,000 feet of okonite for the Washington apartment house now being erected in Kansas City. The company's office is at 522 Delaware street.

The *Revista Telegrafica de Mexico*, F. A. Soni, editor and publisher, is a very creditable publication, emanating, as its name indicates, from the City of Mexico. The paper is well put together, and we welcome it to our list of exchanges. Besides containing much matter of interest in regard to Mexican electrical affairs, it offers a splendid opportunity to American advertisers to reach the Mexican electrical fraternity through their own language. It is the only electrical paper published in Mexico, and claims a large circulation in that country and Central and South America.

The Ball Engine company of Erie, Pa., reports the following shipments of engines during January: California Electric Light company, one 100 horse power; Charles Black, Denver, Colo., one 80 horse power; Dayton Coal & Iron Mining company, Dayton, Tenn., one 100 horse power; the Okonite company, Passaic N. J., one 50 horse power; Edison Electric company, La Grande, Ore., one 50 horse power; B. F. Africa, Huntingdon, Pa., one 80 horse power and one 60 horse power; Brooklyn Street Railway company, Cleveland, O., two 125 horse power; Central Thomson-Houston Electric company, Somerset, Ky., one

80 horse power; Lyle & Lee, Dowagiac, Mich., one 60 horse power; Denver Electric Illuminating company, Denver, Colo., one 80 horse power; Waterhouse Electric company, Baltimore, Md., one 100 horse power; E. S. Greeley & Co., Brooklyn, N. Y., one 35 horse power; Owensboro Electric Light company, Owensboro, Ky., one 80 horse power; Laredo Electric Light company, Laredo, Tex., one 60 horse power; Pueblo Steam Heat & Power company, Pueblo, Colo., one 100 horse power; Alex. Jacobs & Co., Mt. Clemens, Mich., one 100 horse power; Brooklyn Navy Yard, one 35 horse power; Queen City Electric company, Cincinnati, O., one 150 horse power; City of Tecumseh, Neb., one 50 horse power.

One of the oldest firms engaged in the electrical business, in fact one of the pioneers of the business in the West, was the firm of C. E. Jones & Bros. of Cincinnati, which has recently been succeeded by Jones Bros. Electric company. For several years their factory was located on Longworth street, in the heart of the business district of the city, but being unable to secure the accommodations necessitated by their rapidly increasing business, they have recently moved to a large and more convenient factory on Court street. This building is admirably adapted to their purposes. They have a frontage on Court street of almost 100 feet, which extends back to the middle of the block. On the first floor are located the general offices of the firm, the rest of the floor space being used to carry a large stock of supplies of all kinds of electrical goods. A part of the second floor is occupied by a printing office, the rest being used as a stock room, the third and fourth floors, which are light and well ventilated, are used as the manufacturing department of the concern. Here are made all kinds of special electrical and model work, and on the same floor are located a brass foundry, plating room, and a large room filled with lathes of different sizes and styles. The draughting room which is situated in a half story built above the fourth floor and lighted by a skylight is admirably adapted for this purpose. In the basement is a large electric light plant. Power for this plant is furnished by a 200-horse power Hamilton-Corliss engine, which is at present running two 600-light Mather old style dynamos for motor use and one 600-light Mather of the newest type for lighting also a special style of dynamo manufactured by the Jones Bros. company. Two additional 600-light new style Mather machines are on the way and will be in position in a few weeks. The foundations are also laid for two Beck high speed engines, and the plant will be further increased as the demands warrant it. The boilers, two in number, are the McIlvaine Spiegel tubular type. The switch-board, which is a very handsome piece of work, is equipped with a Weston direct-reading voltmeter and four Thomson-Houston current indicators. The switch is a new special double-locking style made by the Jones Bros. company. The mains are all bunched and brought up to a room on the second floor, where all the plugs and switches are located. The light and power system which will extend throughout the business district is being pushed to completion as rapidly as possible and the service given will be of the best possible kind. At present the full operation of the plant is being delayed somewhat by injunction suits which have been filed by other companies to prevent the Jones Electric company from using their poles under the rules adopted by the city department of public works, but it is believed that these delays will not prevent the projected extensions longer than a few weeks.

The Western Electric Construction company was established in Kansas City in 1886, and since then has had a most prosperous career. Ford S. Caldwell is proprietor and M. E. Bates is manager. Since it began business this company has established the following central station plants: Edison Illuminating company, Topeka, Kan.; Hutchinson Water & Electric Light company, Hutchinson, Kan.; Abilene Water & Electric Light company, Abilene, Kan.; S. B. Pierce & Son, Lawrence, Kan.; Edison Electric Light & Power company, Kansas City; Fort Scott Electric Light & Power company, Fort Scott, Kan.; Citizens' Electric company, Wichita, Kan.; Pine Bluff Water & Electric Light company, Pine Bluff, Ark.; Trinidad Electric company, Trinidad, Colo.; North East Street railway, Kansas City, Mo. Isolated plants, Kansas City—Kansas City *Times*, Dime Museum, Centropolis hotel, Richardson & Heines Star Planing mills, New England building, Board of Trade building, Rialto building, Exposition building, Woodland hotel, Coates house, *Journal* building, Bonaventure house, Gibraltar building, Metropolitan Street railway, Ninth and Wyoming, Metropolitan Street railway, Twelfth and Charlotte, Grand Avenue railway, Grand avenue and Fifteenth street, Kansas City Cable company, Eighth and Woodland, Kansas City Cable company, Ninth and Washington, Landis Court, Eighteenth and Broadway, Kingan & Co., packers, Armourdale, Chapin & Gore, restaurant, Martin Regan, saloon, Gus Behr, restaurant, M. B. Wright, store, S. M. Jarvis, residence, F. M. Howe, residence, W. W. Arnold, residence, Blossom house, V. B. Bell, residence, Frank K. Hoover, residence, Railway Mail Service, St. Mary's Church. Isolated plants, St. Louis—St. Louis Exposition, Anheuser-Busch Brewing association, Belcher Sugar refinery, Lindell hotel, Fairbanks & Co.'s lard works, Beers' hotel, Grand Opera house, Olympic theater, Pope's theater, Kennard & Sons' carpet house, Victoria flour mills, Southern mills, Baldwin's exchange, Steamer Nisbet, Frank & Sons, Park mills, Camp Spring mills, Blackmer & Post, Deidrich Furniture company, Bemis Bagging company, Anchor mills, Dr. Ehrhardt's residence, Woodward & Tiernan, printers and stationers, Meyer Bros.' Drug company, Grand Opera house, *Globe-Democrat*. Isolated plants, miscellaneous—Fort Scott, Kan.; Foundry & Machine company, Dallas, Tex., *Herald;* Howard Oil company, Dallas, Tex; Kansas State Penitentiary, Lansing, Kan.; Henderson, Ky., Cotton mill; Border City Ice & Coal company, Fort Smith, Ark.; Perry Hutchington Flour mill, Marysville, Kan.; Crystal Ice company, Little Rock, Ark.; Topeka, Kan., Insane asylum; Fulton, Mo., Insane asylum; Kansas City Dressed Beef company, Rosedale, Kan.; National Manufacturing company, Nashville, Tenn.; De Soto, Mo., central station; Kansas City Smelting & Refining works, Argentine, Kan. The company has its offices on the second floor of the Electrical exchange, the National Bank of Kansas City building at Fifth and Delaware streets.

Electrical Patents.

Issued Feb. 4, 1890.

420,444. Thermal Cut-Out. George Farrell, New York, N. Y.

420,469. Regulation of Electric Motors. Lemuel W. Serrell, Plainfield, N. J., and Harvey L. Lufkin, New York, N. Y.

The first claim follows:

"1. The combination, with the main exciting coil of an electric motor, of a differential coil in parallel with the main exciting coil, both coils being in series with the armature, and a speed-governor controlled by the motor and controlling the current flowing through the differential coil in accordance with the work done."

420,500. Electric Drill. Imle E. Storey, Boulder, Colo.

420,543. Electric Street Car Gear. Edgar Peckham, New York, N. Y.

420,544. Electric Car Gear. Edgar Peckham, New York, N. Y.

420,545. Electric Car Axle. Edgar Peckham, New York, N. Y.

420,552. Extension Electrolier. James E. Brown and John F. Brown, Brooklyn, N. Y.

420,563 Automatic Bolt Work. Oliver F. Pillard, Cambridge, Mass.

420,594. Quadruplex Telegraph. Thomas A. Edison, Menlo Park, N. J. Filed Aug. 22, 1877.

The third claim reads as follows:

"3. The combination, in a quadruplex telegraph of an electro-magnet in the main line circuit and an armature set to respond to maximum and medium strengths of current and a sounder brought into action by such armature, a second electro-magnet in the main line circuit, and an armature set to respond to medium and minimum strengths of currents, and a sounder and local circuit brought into action by such armature."

420,611. Electric Brush. John E. Stephens, Cincinnati, Ohio.

420,622. Electrical Lock Switch. Edward N. Dickerson, Jr., New York, N. Y.

The claim is appended:

"The combination of the switch making opposite connections and moved by two controlling magnets with an independent mechanical lock locking the said switch in each of its two connections, the mechanical lock being controlled by an independent magnet in the circuits with both of the controlling magnets."

420,635. Staple for Electrical Conductors. Luther Stieringer, New York, N. Y.

420,638. Cable-Hanger. William A. Conner, Pittsburgh, Pa.

420,641. Method of Electric Refrigeration. Mark W. Dewey, Syracuse, N. Y.

The main object of the invention is to distribute cold produced by electricity in a certain locality to or through one or more localities from where the cold is produced.

Claim: "42. The method of electrically changing temperature, consisting in removing heat from or disengaging heat in a medium by or through the convection or conduction of heat produced by an electric current or currents, and circulating or passing said medium through a locality wherein the temperature is to be changed."

420,648. Insulating Compound. James B. Williams, San Francisco, Cal.

The first and last claims follow:

"1. An electric insulating compound which consists of India rubber, paraffine, and a resinous body.

"6. The process of making the insulating compounds which consists in, first, dissolving the India rubber in a volatile solvent; second, dissolving paraffine in the India rubber solution thus obtained; third, distilling from the solution of India rubber and paraffine the volatile solvent, and, fourth, incorporating the resident compound of India rubber and paraffine with one or all of the remaining ingredients."

420,693. Electro-Magnetic Car Brake. Daniel S. McElroy, New York, N. Y.

420,697. Burglar Alarm. Noah M. Powell, Reger, Mo.

420,705. Electric Lamp Adapter. James Stewart, New York, N. Y.

420,706. Electric Lamp Adapter. James Stewart, New York, N. Y.

420,710. Bipolar Prostatic Electrolyzer. Richard M. Bache, Philadelphia, Pa.

420,740. Electric Belt. Albert J. Sheffield, Griggsville, Ill.

420,762. Electric Meter. James D. Bishop, Chicago, Ill.

The object of the invention is to provide an improved registering-meter for electric currents which shall serve to register with accuracy the quantity of current passing through it and indicate the same in a manner intelligible to the general consumer, as in case of a gas meter.

420,764. Thermo Electric Generator. Charles S. Bradley, Yonkers, N. Y.

420,771. Elevator. John H. Clark, Boston, Mass.

The invention consists in the combination with an elevator car and a motor mechanism to move it, of an electric device to control the operation of said motor mechanism, a switch carried by the car provided with circuit-terminals, and a speed regulating device connected to said electric device and to the circuit-terminals on the car, whereby the speed or rate of movement of the elevator car may be regulated as desired from the car.

420,804. Conduit for Electric Railways. Delbert E. Johnson, Atlanta, Ga.

420,816. Electrically Reciprocated Tool. Harry N. Marvin, Syracuse, N. Y.

420,833. Autographic Telegraph. James H. Robertson, Brooklyn, N. Y.

420,834. Electric Door-Opener, George A. Seib, New York, N. Y.

420,850 Electrical Recording Instrument. Frank B. Wood, New York, N. Y.

420,851. Method of Electrically Recording Signals. Frank B. Wood, New York, N. Y.

The claim is as follows:

"The method of electrically recording signals, which consists in imprinting upon a recording medium the figures indicating the time at or about which the signal is recorded in a succession of impressions corresponding in number and relative location to and representing the number of the signal."

420,852. Apparatus for Electrically Recording Signals. Frank B. Wood, New York, N. Y.

420,858. Electric Railway Signal. George W. Boss, Minneapolis, Minn.

Claim four:

"In a railway signal system the combination of a main wire having contact strips and ground connection at both ends and having resistance coils between said contact strips and the ground connections, local circuits provided with suitable signals, and circuit closer magnets for said local circuits arranged in said main wire."

420,859. Electric Railway Signal. George W. Boss, Minneapolis, Minn.

The object of this invention is to provide an improved block signal system for railroads, in which as a train passes into each section, it will set a signal at each end of the block to indicate danger, and as it passes off from the block to indicate safety, and which is adapted for use either with a single or double track and which operates equally well whether the train is passing in one direction or the other.

420,881. Filament for Incandescent Lights. Rudolf Langhans, Berlin, Germany.

The claim follows:

"A filament for incandescent electric lamps, consisting in a vein or core composed of salts, the basic component of which consists of an oxide or oxides of earthy metal, and the acid component of that class of oxides which in the presence of the former and on exposure to a high temperature assumes the character of acids, the vein or core being coated with material of higher electric conductive capacity than the core."

420,882. Electric Regulating Mechanism. Herman Lemp and Merle J. Wightman, Hartford, Conn.

The invention consists in the combination with motor mechanism of a retarding device having a variable retarding effect in both directions of movement of said mechanism which effect is governed or adjusted automatically by the controller magnet or by a magnet in circuit therewith or controlled thereby, and either directly or indirectly in such way that the magnitude of the change in the power of said controller magnet shall effect a corresponding change in the adjustment of the retarding mechanism so that with a large change the latter shall retard the motor mechanism to a less degree, and therefore allow a quick or rapid movement of the same in either direction. The retarding mechanism consists in a dash pot with a variable resistance.

420,884 Multiple Telegraphy. Ernest J. P. Mercadier, Paris, France.

The fundamental feature of this invention is based upon the fact that if upon a continuous current in a line a particular set of rhythmical undulations is superimposed, the latter may be made to actuate a suitable receiving instrument constructed to respond to that particular rhythm of current undulations, and to no other, and that if at the same time electrical undulations of different rhythms are superimposed upon the continuous current, receiving instruments constructed to respond each to one of those added rhythmical undulations may be used for the reception of messages spelled out by the added undulations.

420,890. Electric Time Alarm and Indicator. Charles A. Randall, London, England.

420,894. Rheostat. William Thomson, Glasgow, County of Lanark, Scotland.

420,906. Apparatus for Charging and Discharging Secondary Batteries. Warren S. Johnson, Whitewater.

Claim one:

"In commutators for secondary batteries, the combination of a slide having upon it two or more series of contact pieces arranged, so that a change of position of the slide in relation to the terminals or poles of the secondary batteries will commute the current differently, the poles or terminals of a series of secondary batteries, and an electro-magnet or solenoid in circuit, so that the starting of the current will commute it differently."

420,924. System of Generators. Addison G. Waterhouse, Hartford, Conn.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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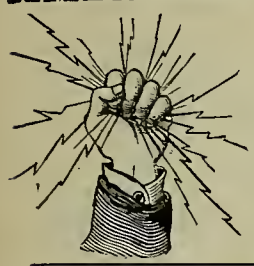

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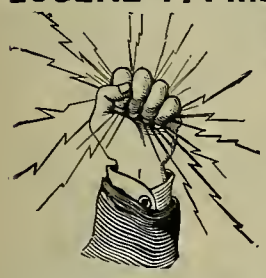

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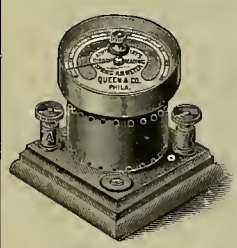

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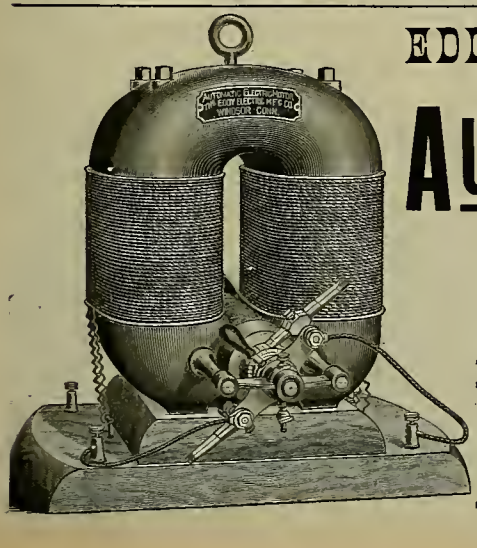

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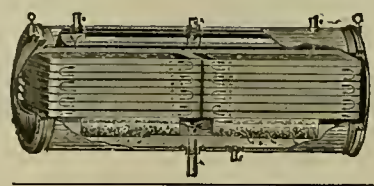

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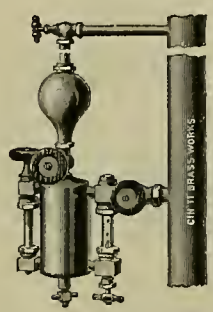

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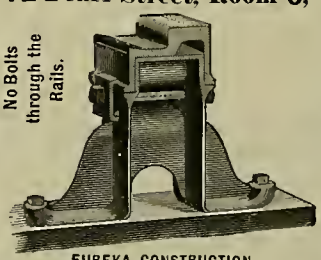

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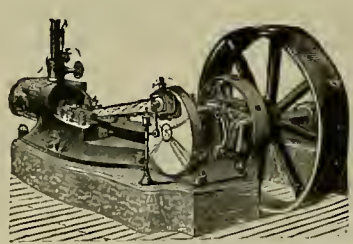

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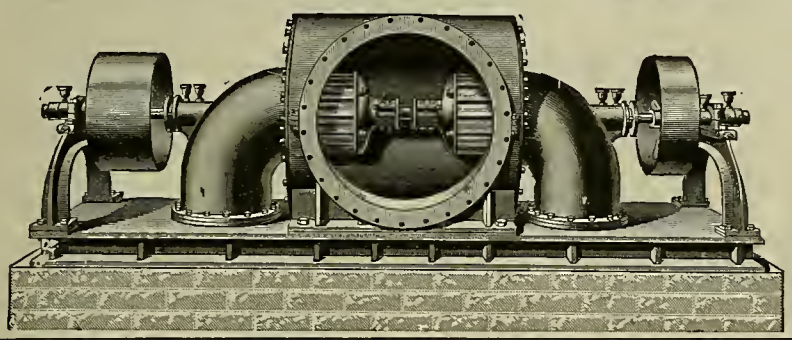

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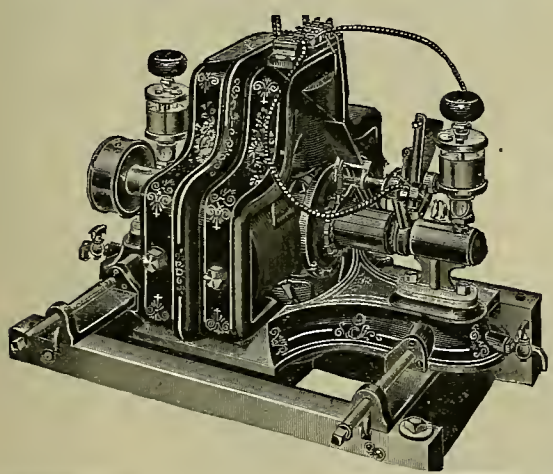

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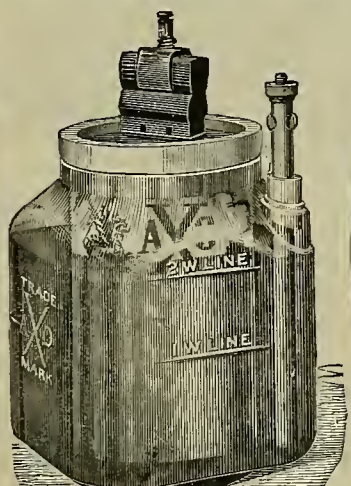

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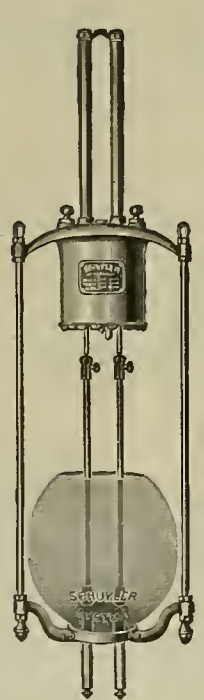

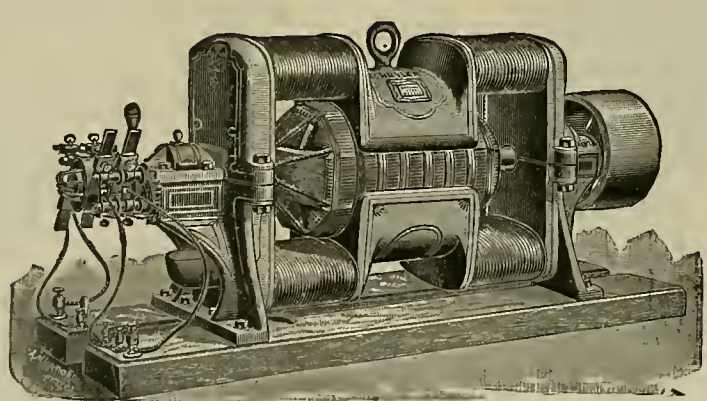

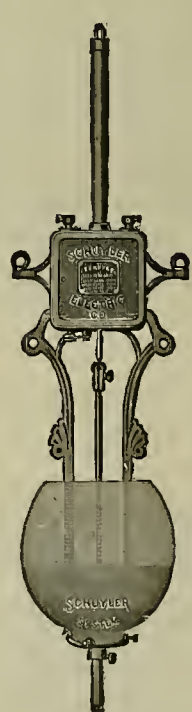

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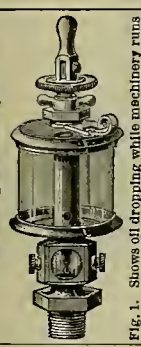

The Filling Hole in Top Cap is covered with Sneb Lever, which cannot be displaced by jarring or shaking of machinery.

Fig. 1. Shows oil dropping while machinery runs

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Fig. 2. Shows flow if oil stopped when machinery stops.

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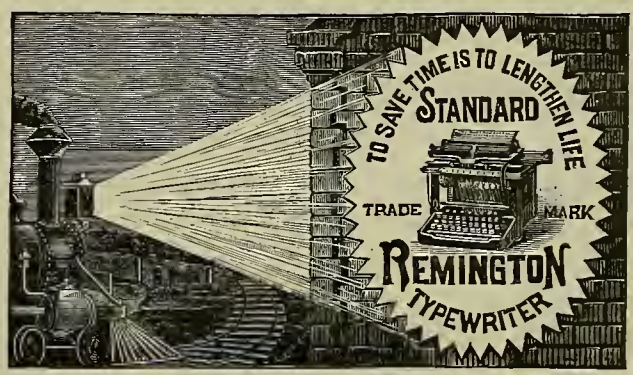

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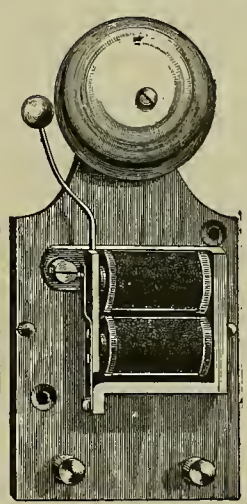

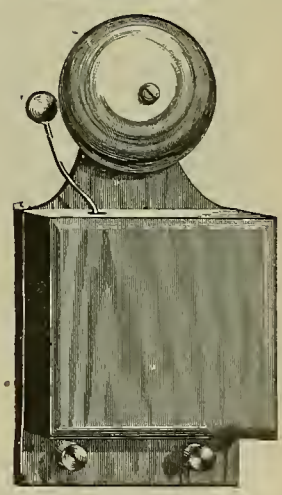

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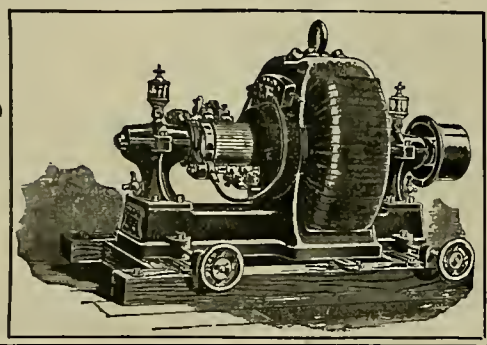

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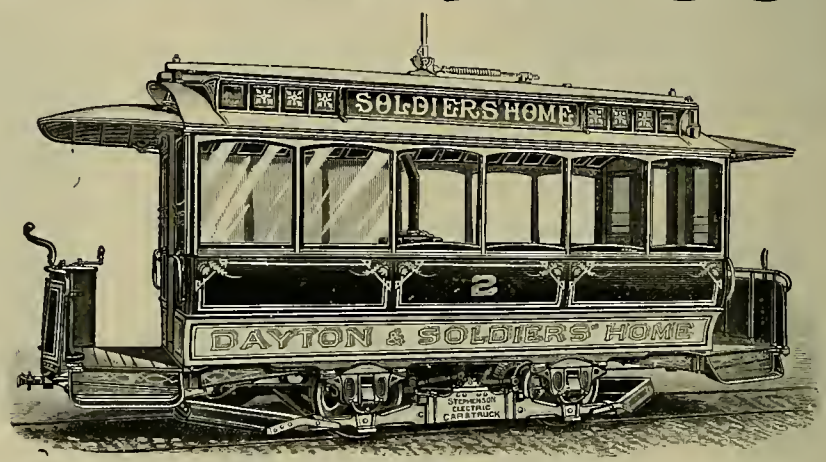

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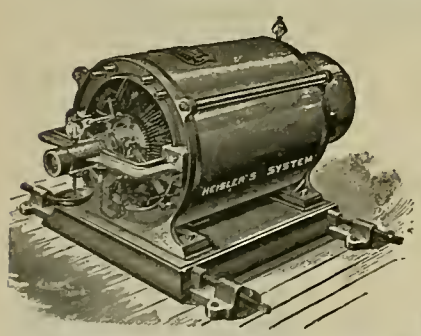

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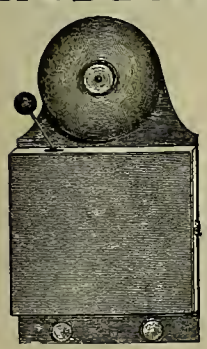

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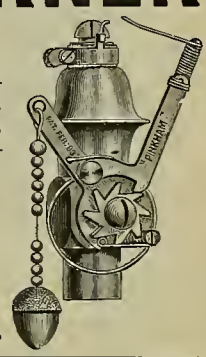

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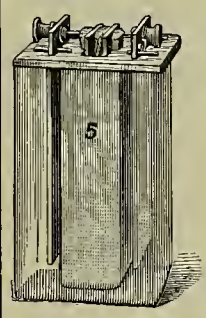

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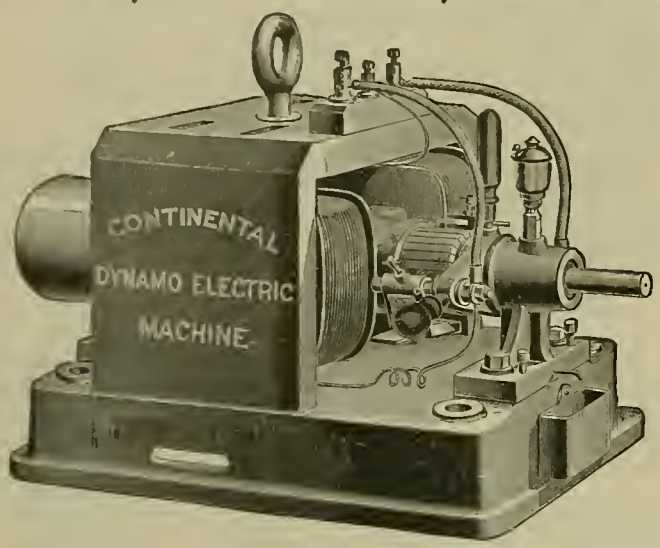

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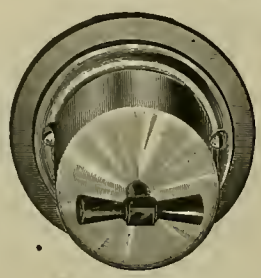

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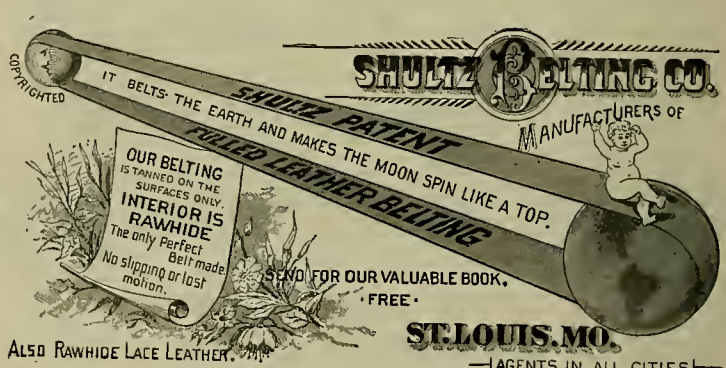

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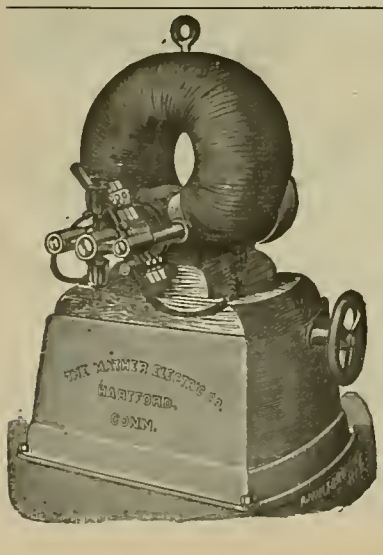

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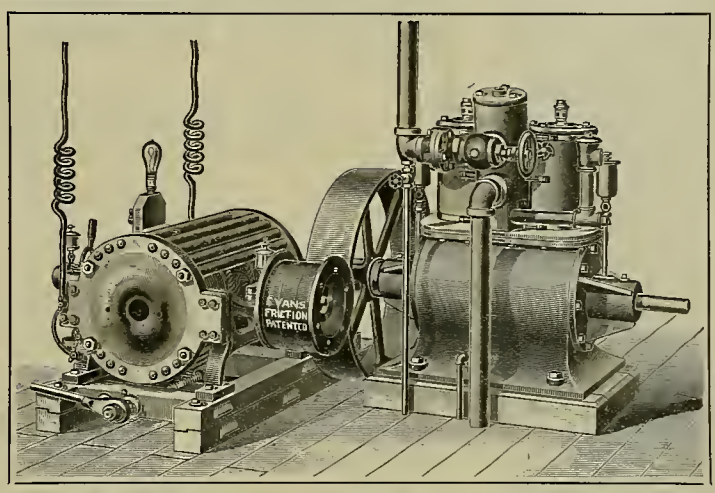

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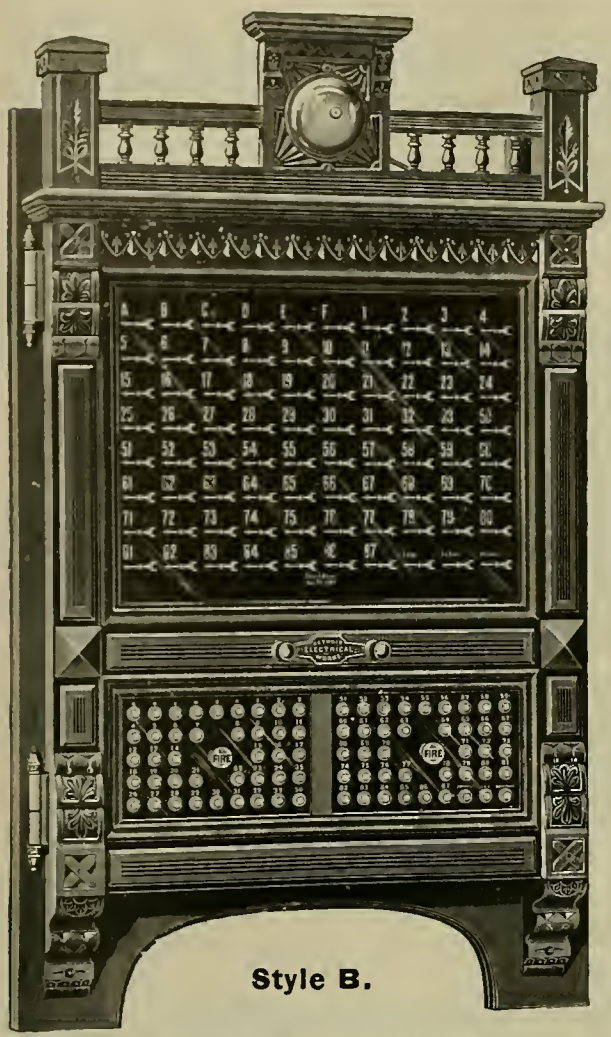

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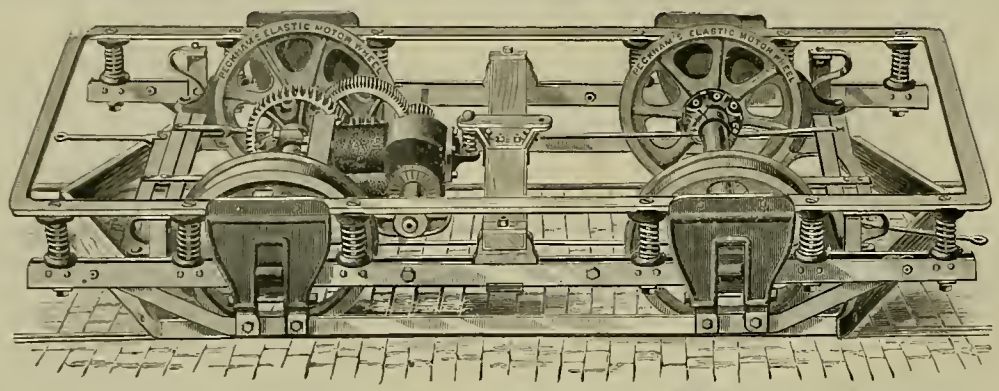

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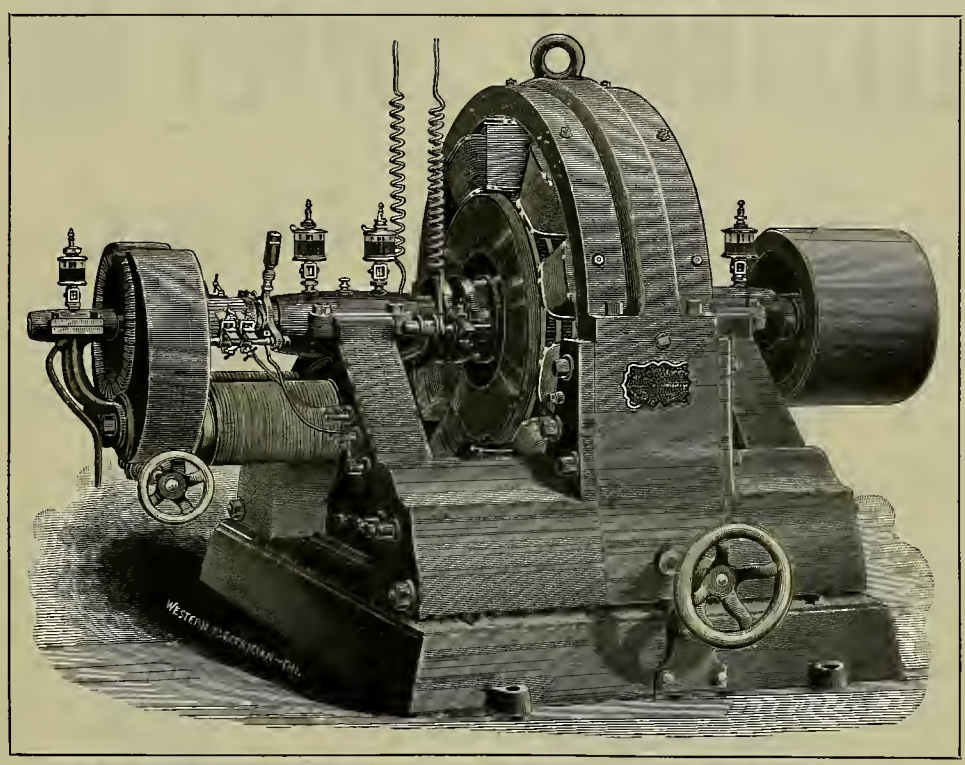

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TRADE SUPPLEMENT. CHICAGO, FEBRUARY 15, 1890. No. 1

Central Electric Company, Chicago.

The building, offices and salesroom occupied by the Central Electric company of Chicago, are illustrated in the accompanying cuts. The headquarters of this company are now at 116 and 118 Franklin street, and it can safely be said that there can be found no more complete line of electrical goods in the West. The facilities for handling goods are unsurpassed and all things considered, the company has quarters unexcelled by those of any electrical supply house in the West. The building which the company occupies has been specially designed for their business and contains, perhaps, more floor-space than any other house in Chicago, selling electrical supplies exclusively. With a frontage of 50 feet on Franklin street and a depth of 100 feet, the building secures ample light from three sides as there is an alley in the rear and another on the south side of the structure. In addition to the advantages for light, the situation has unequaled facilities for shipping.

A glance at Fig. 1, which represents the front of the building, will convey an idea of the magnitude of the business which occupies this structure. On approaching from the south, the most conspicuous object on Franklin street is the immense wire sign suspended over the street bearing the word "Okonite," curved to represent the well-known trademark of that excellent wire. The Central Electric company is general western agent for this staple article, and in fitting up its new quarters has made special provisions for handling the largest stock of "Okonite" in the country. The spacious storerooms assigned to this department contain a stock of wire which the company claims cannot be reproduced in the country. It is moreover, the intention of the company to continue as it has begun and always keep a complete stock of this celebrated wire on hand. It will have no trouble whatever in filling its orders, no matter how large they may be, as the facilities of the new factory at Passaic, N. J., are such that it can on short notice turn out immense quantities of wire. The importance and magnitude of the business of this single department may be realized, when it is known that 8,000 square feet of floor space is occupied in the store rooms of the Okonite and Candee wires alone and that the stock is piled in tiers to the ceiling.

The offices and salesrooms, as well as the shipping department, are all on the ground floor. Large plate glass windows furnish ample light under ordinary conditions, but in order to secure perfect illumination on all occasions the entire building has been wired for incandescent lights and connection made with the mains of the Chicago Edison company. As can easily be imagined the effect of this excellent light on the well appointed offices and salesrooms is indeed striking. Neither pains nor expense has been spared to make the offices and salesrooms as handsome, convenient and attractive as can be found in any business house in Chicago. A visitor cannot fail to note the excellent taste displayed in the selection of colors and the general arrangement of the furnishings. The decorations and finishings are exceedingly attractive and cannot fail to favorably impress the observer. The executive offices are at the front of the building and are represented in Fig. 2. They are well lighted, handsomely furnished in oak and cherry, and are fitted with all modern conveniences. An extra desk with writing materials has been provided for visitors and patrons of the company. This is an innovation and one that should be appreciated, as it is certainly a convenience that has long been needed. The executive offices are separated from the other offices and from the salesrooms by partitions, the upper portion of which are of plate glass. In Fig. 3 the main salesroom is shown, in which it will be seen there are well-stocked shelves containing everything desirable in the supply line. At the rear of this salesroom is the shipping department, which is a model of convenience. Along the walls are arranged bins and above these shelves, the latter partitioned off into boxes, in which small articles are kept so as to be close at hand and convenient for shipping. The facilities for packing and shipping goods are unsurpassed, nor are the arrangements for the reception of stock less complete. An immense chute conveys the freight from the wagons on the street into the cellar, making it possible to receive an immense amount of freight daily. Part of this freight is stored in the cellar—huge coils of cable and such articles as might suffer from handling. All other articles, however, are transferred to the upper floors, where they are arranged in their respective departments. So thorough is the system inaugurated by this company that the stock keepers by a glance can tell the condition of each department.

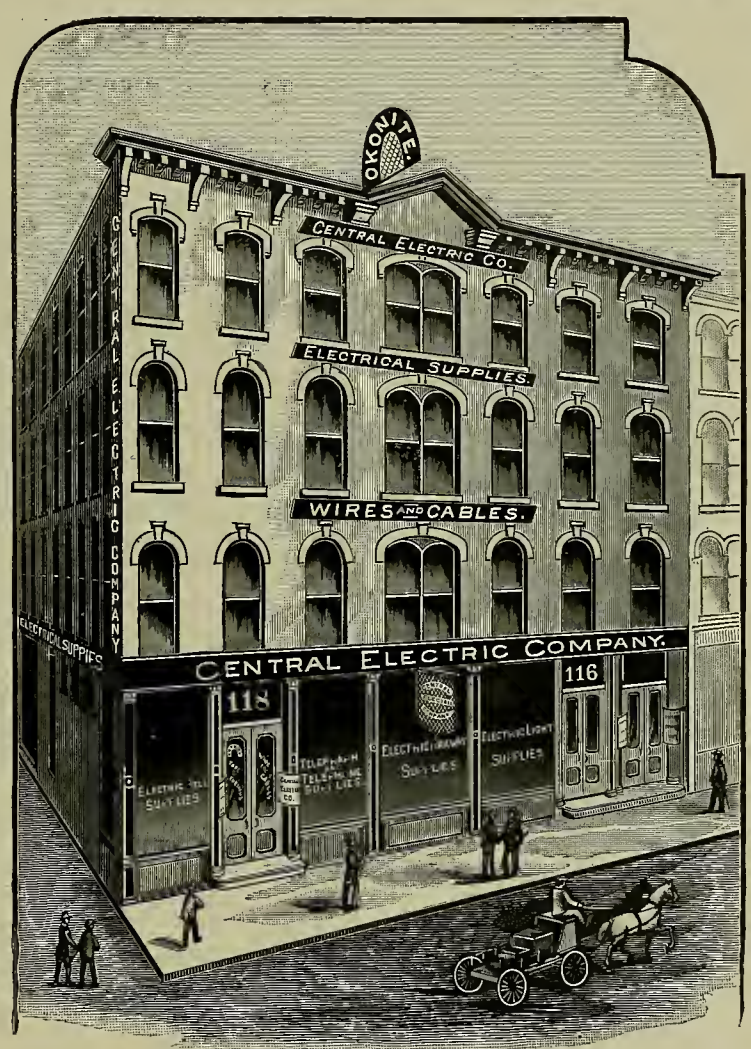

FIG. 1.—CENTRAL ELECTRIC CO., CHICAGO—FRANKLIN STREET BUILDING.

Electricity pervades everything about the establishment. It furnishes light and is utilized to call messengers, establishes communication between the several departments and the offices, and connects the place by telephone with the rest of the city. But it does more—it furnishes power and one of its applications is the operation of the freight elevator by a 5-horse power motor which is stationed in the cellar. The machine thus far has given entire satisfaction. During the warm summer months small motors will be utilized to operate ventilating fans, which will keep the offices and salesrooms comfortably cool. As new applications of electricity are discovered, they will be utilized here, as it is the intention of the company to make in this establishment an illustration of the numerous departments of the wonderful power which has been the foundation of the success of this company. It is therefore hoped in a short time arrangements may be perfected for the heating of the establishment by the same subtle agent.

In addition to the establishment on Franklin street, Chicago, the company has an extensive factory at Columbia City, Ind., in which it manufactures pins and brackets for telegraph and telephone construction work, turning out over 2,500,000 annually.

In this connection, a few words about the company and its history would not be amiss, though both are so closely identified with the recent advancement of electrical interests in the West, as to need no introduction. The Central Electric company has been organized only three years, but that it is a vigorous infant and gaining strength every day, can well be appreciated by all who know the extent of the business it has built up in so short a time. The excellent business principles which have been followed since the organization of the company, cannot but continue to press it upon public favor. The projectors of the enterprise were W. H. McKinlock, who at that time was secretary of the Detroit Electrical company of Detroit, Mich, and George A. McKinlock, formerly auditor of the Michigan Telephone company. To them is due the credit for building up one of the largest electrical supply houses in the country. So rapid has been the advancement of this concern that it was found necessary quite recently, to reorganize the company on a larger scale.

Accordingly the capital stock was increased to $250,000, the new building which is herewith described was secured, and many other important changes were made. The officers of the new company are: President, W. H. McKinlock; treasurer, George A. McKinlock; secretary, F. W. Cushing. Mr. Cushing, the new member of the company, entered about the time of the reorganization and was elected secretary. He is well known in electrical circles and his familiarity with the business makes him a valuable addition to this enterprising concern. He is moreover, thoroughly acquainted with all the departments of electrical science, has a practical knowledge of construction work, and his wide experience in this department, well qualifies him for the supervision of the department of furnishing estimates and information. He will give his personal attention to this work and will also act as consulting engineer. His former work in this field was in connection with the establishment of the present system of underground conduits in Chicago, the construction of which he superintended. He was instrumental in organizing the Chicago Arc Light & Power company, and was superintendent of that company for a long time. Later he was associated with Prof. Elisha Gray of Highland Park and the Western Electric company of Chicago.

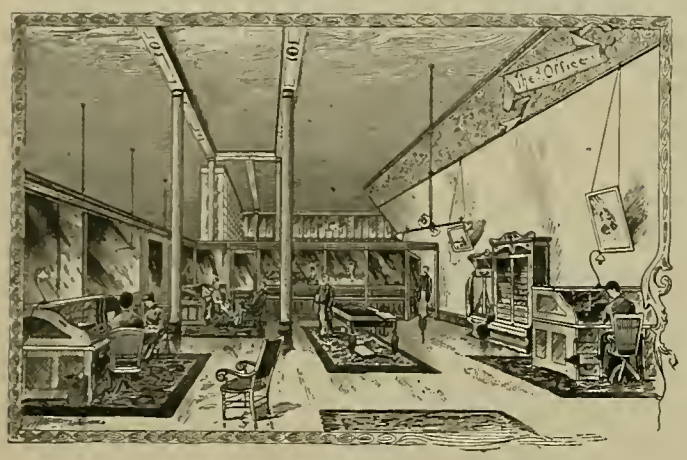

FIG. 2. EXECUTIVE OFFICES.

FIG. 3. SALESROOM.

CENTRAL ELECTRIC CO.

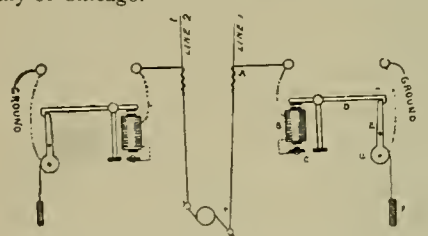

FIG. 2. CENTRAL LIGHTNING ARRESTER.

Few who have not had experience in the electrical supply business can fully appreciate the importance of this branch of the industry, the amount of capital invested and the number and variety of devices which must be always carried in stock. The Central Electric company's headquarters is rightly called a supply house, for there all the electric construction companies find the numberless devices required in the several departments of their business. Electric light companies, both arc and incandescent, have recourse to these warerooms for fixtures, wire, etc., which they themselves could not keep in stock, but which can always be found here. It is the same in all other departments of electrical activity. Telephone, telegraph and motor companies can find anything that their particular line requires, but there are many other instruments required by the amateur and expert in their experiments and tests, which can only be found in such houses as this. The Central Electric company has made a special feature of this department and its stock of testing instruments, whether for laboratory experiments or central station use, cannot be excelled. The number and variety of these devices and the necessity of securing only standard instruments, will explain the care which the company has exercised in the selection of its line. The success attained in establishing a reputation for this line has encouraged the company to create a special department, which will be under the personal supervision of an experienced man. Information on all subjects connected with this department will be readily furnished.

Visitors to Chicago are always welcomed at the headquarters of the Central Electric company, and every effort is made to afford them all the conveniences possible during their sojourn in the city. Those who may desire to see an example of the wonderful growth of the electrical interest in the West, will find no better opportunity than an inspection of the new headquarters of this young and enterprising concern.

The Central Lightning Arrester.

The lightning arrester illustrated in this article presents some new features that are worthy of attention. It is necessary in the application of this arrester, as with other types, to place one instrument on each side of the dynamo. With certain forms of arresters the objection to this has been the danger of short-circuiting the dynamo through the two grounds in case the arrester points became fused together—a danger by no means to be overlooked. The feature, therefore, of this device which will be thoroughly appreciated by those who have used most of the arresters now on the market, is the impossibility of an equilibrium being established between the magnet and the arc drawn at the point of separation. When brought into action the points begin to separate the instant the magnet is acted upon, and immediately there follows a complete and absolute break of the arrester circuit.

Referring to Fig. 2, it will be seen that the surplus charge coming in on line, 1, leaves the same at *A*, passes around the electro-magnet, *B*, jumps across the carbon points, *C*, passes through the levers, *D* and *E* to ground. The dynamo current following the atmospheric discharge, passes around the electro-magnet *B*, acts upon the same and attracts the armature of the lever *D*, which in turn releases the lever *E*. The moment the lever *D* starts on its journey, the carbon points *C* begin to separate, thus preventing their fusing together, as they would be liable to do, were they fixed. When the armature approaches *B* sufficiently, the arrester circuit is entirely broken by the lever *E* flying out of engagement with *D*, where it is held by the weight *E*, suspended by a string wound around the drum *G*. Upon this breaking of the arrester circuit, *B* loses its magnetism, the lever *D* falls back into position and engages the lever *E*, after the same has described a circle. The arrester is thus automatically set for the next discharge and can take discharges in rapid succession, until the weight runs down. When this occurs, it can be quickly and safely wound up again by turning the lever *E* in the reverse direction, the lever being provided with an insulated handle for that purpose. This action also applies to line No. 2, the connections on both lines being identical. This arrester is being introduced by the Central Electric company, Chicago.

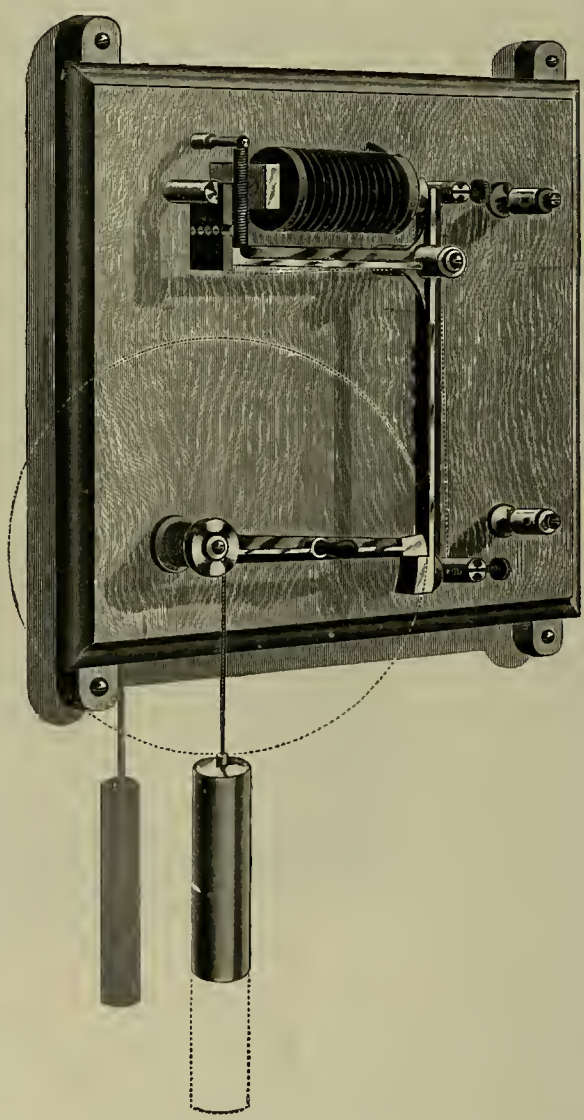

FIG 1. CENTRAL LIGHTNING ARRESTER.

IMPORTANT.

BRUSH PATENT SUSTAINED.

The broad right to the use of Double Carbon Electric Arc Lamps declared to belong to the Brush Electric Company, under U. S. Letters Patent to Charles F. Brush, No. 219,208.

In the suit of The Brush Electric Company vs. The Fort Wayne Electric Light Company, decided at Indianapolis, Dec. 24, 1889,

JUDGE GRESHAM HOLDS:

1 *That Brush was the Pioneer Inventor in Commercial Arc Lighting.*

2 *That the Brush Patent in suit is the Pioneer Patent for Double Carbon Arc Lamps.*

3 *That the Patent is Broad and Fundamental.*

4 *That all its Claims (six in number) are valid.*

5 *That the claims of the Patent are all infringed by the Defendant.*

The Court says: "The separation of the two pair of Carbons, so that the Arc is established between one pair and maintained between the Carbons of that pair until they have been consumed and then automatically established between the Carbons of the other pair and maintained between them until they have been consumed, is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the Lamp in suit from all prior lamps."

The Brush Electric Company is assured by the most competent legal advisers that under this Brush Patent, as interpreted by the U. S. Circuit Court, practically all Double Carbon Electric Arc Lamps now offered for sale are

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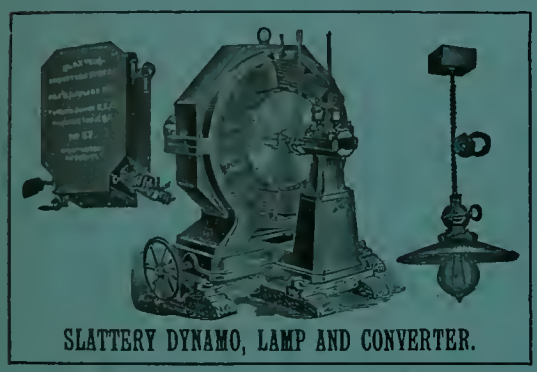

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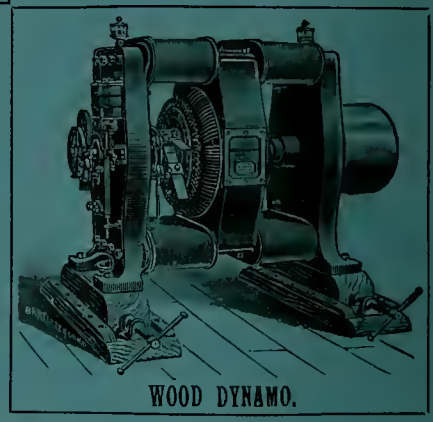

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CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

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SEE PAGE XXVI.

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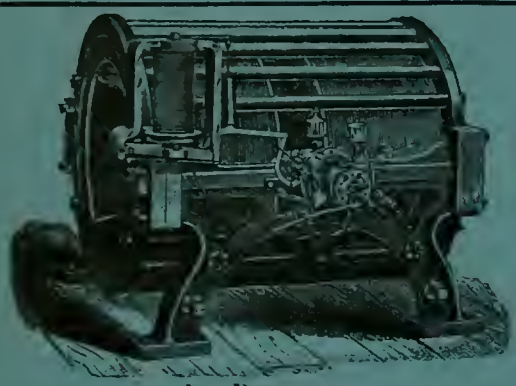
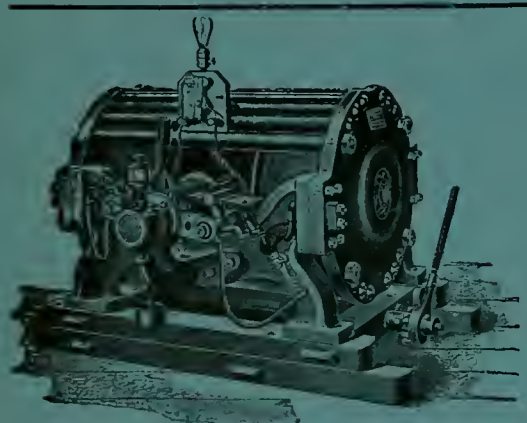


Arc Dynamo.

No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent., are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.



Direct Current Incandescent Dynamo.

Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.

Alternating Current Dynamo.

The problem of long distance incandescent lighting is practically solved by the alternating current dynamo, and to meet the demand for a machine of this character we have constructed what is unquestionably the most perfect alternator offered the public to-day, embracing as it does, all the features that combine to make a perfect dynamo—automatic regulation, perfect mechanical construction, highest efficiency, and economy of operation.

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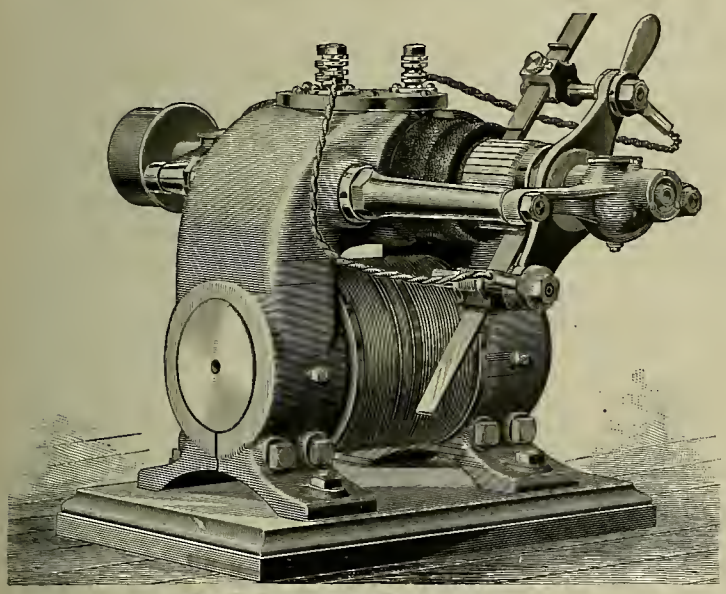
The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

LIGHTNING ARRESTER.—All of our installations are protected from destruction and injury by our lightning arrester, which we will fully guarantee to operate successfully in every instance. The Company guarantees to repair or replace apparatus injured by lightning where these arresters fail to operate.

JENNEY ELECTRIC MOTOR CO.,



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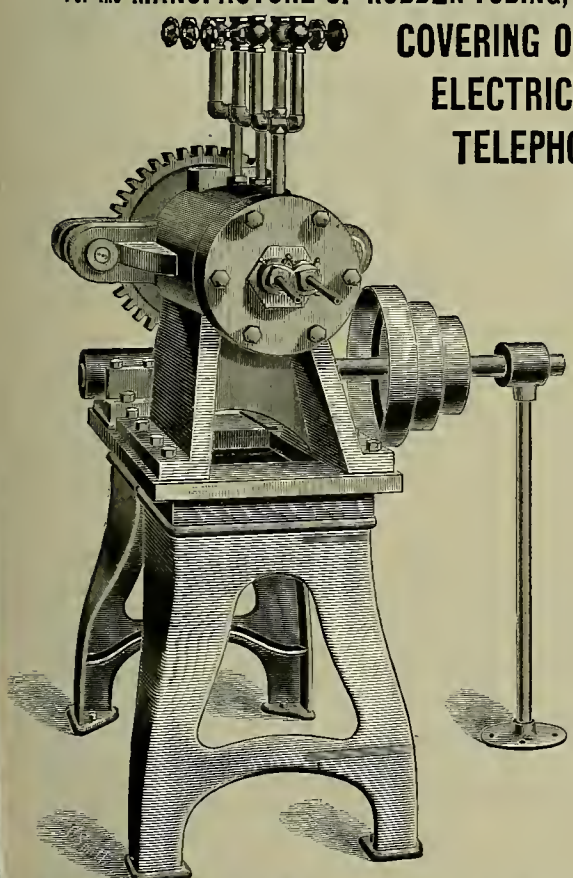
For the MANUFACTURE OF RUBBER TUBING, and also the

COVERING OF ELECTRICAL AND TELEPHONE WIRES.



To meet the inquiries and wants of the Electrical Trade, we have perfected a new head to this machine for the covering of electrical wires with the various insulating compounds now in use. Having made several of these for the trade, and finding them giving good satisfaction, we offer it to your consideration.

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Rubber Monlds and Rubber Machinery a Specialty.

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Gentlemen:—I have made an extensive series of tests of your **WHITE CORE INDIA RUBBER INSULATION,** under various conditions of temperature and times of immersion in water, with the following results:

INSULATION RESISTANCE IN MEGOHMS PER MILE:

Time	5 min.	1 hour.	24 hours.	10 days.	24 days.
Temperature	60° F.	60° F.	60° F.	60° F.	60° F.
Resistance	3,200	3,300	3,300	3,300	3,300

Time	30 min.	30 min.	30 min.	30 min.
Temperature	40° F.	115° F.	167° F.	200° F.
Resistance	3,900	162	12	5.2

The times given in the upper table are those between the immersion of the wire in water and the making of the test.

The times of the second table indicate the time between that at which the tank reached the indicated temperature and that at which the test was made.

The cable had been immersed in water for a month before the first temperature test was made.

It will be observed that the temperature being at 60° F. the resistance remained constant at its highest point for 24 days, and than raised greatly on lowering the temperature.

The lowering of resistance by a rise in the temperature is a common characteristic of all such insulations and indicates no defect. Most insulations are much more affected by this cause than was this one.

This wire also showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas. Very truly yours,

(Signed) HENRY MORTON.

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SELLS OUR WIRES IN THAT VICINITY.

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FOR INCANDESCENT CIRCUITS.

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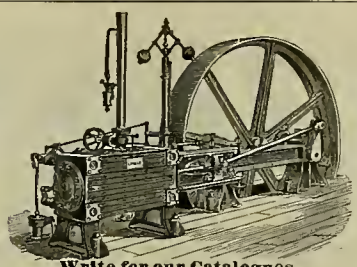
IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



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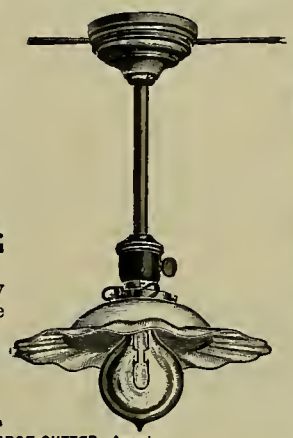
SIMPLE. RELIABLE. DURABLE.



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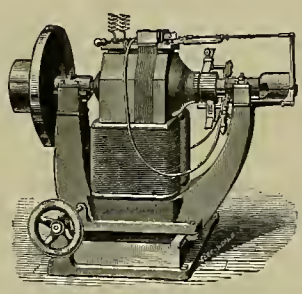

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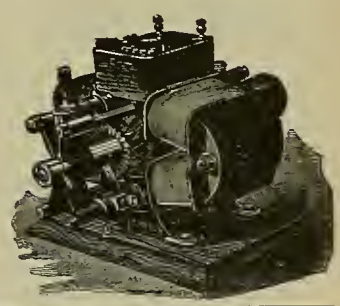

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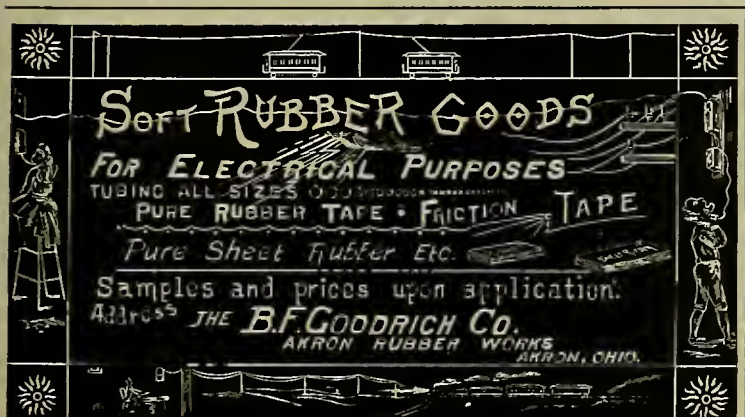

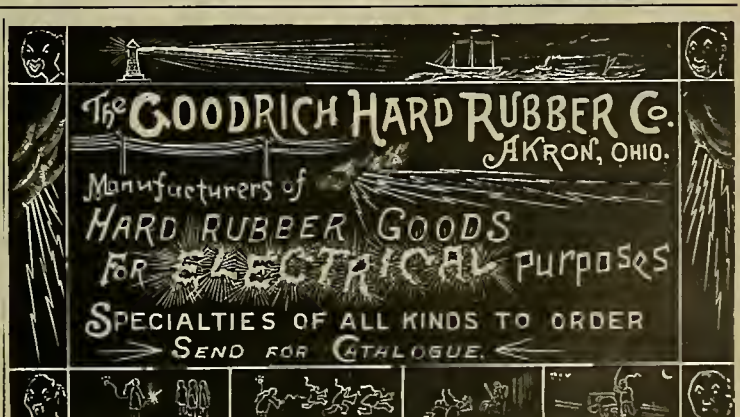

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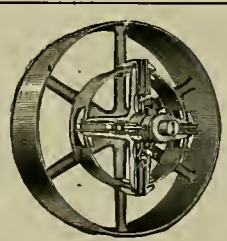

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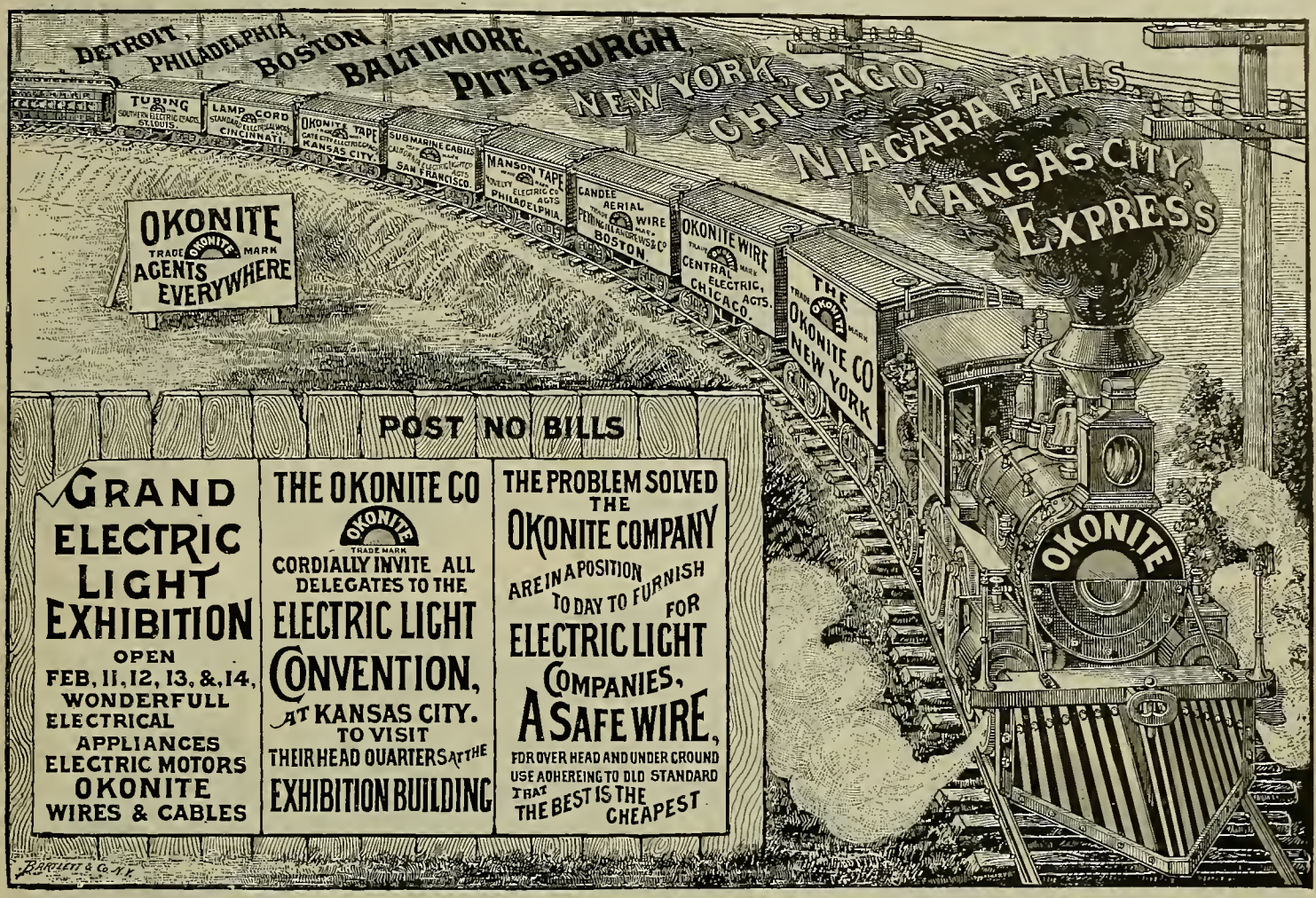

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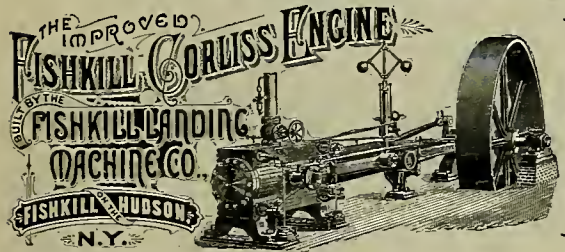

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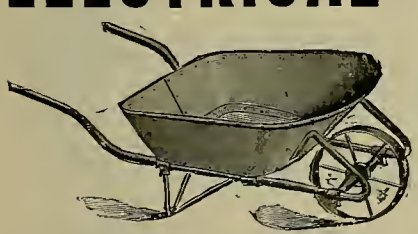

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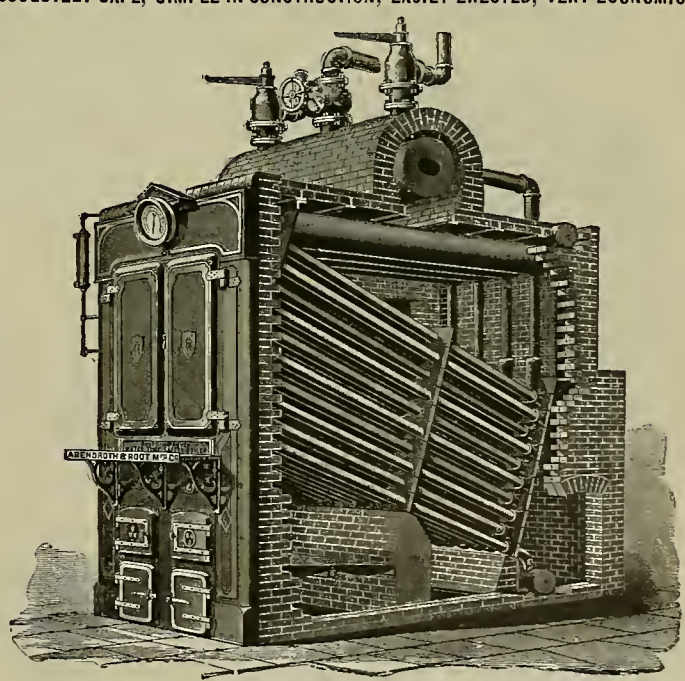


IN USE FOR THE PAST 20 YEARS THROUGHOUT THE WORLD.

Adopted by the Electric Light Companies of Cincinnati, Louisville, Detroit, Columbus, Philadelphia and many others.

ABENDROTH & ROOT MFG. CO.,

28 CLIFF STREET, NEW YORK.

BRANCHES: BOSTON, CHICAGO, PHILADELPHIA, NEW ORLEANS.

"C. & C." ELECTRIC MOTOR COMPANY,

402 & 404 GREENWICH STREET, NEW YORK.

ALL STANDARD SIZES

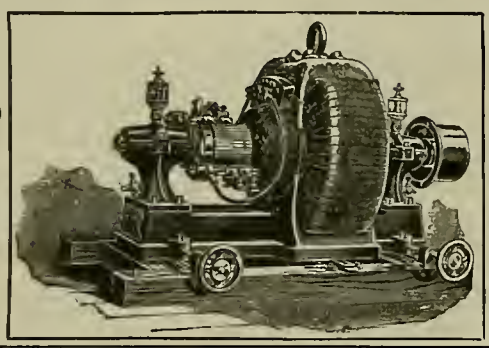
—OF—

ELECTRIC MOTORS

—FROM—

1-8 H. P. TO 40 H. P.

Chicago Office, Phœnix Building.
Cincinnati Office, 165 Walnut Street.



Over 6,000 Now in Use

—IN THE—

UNITED STATES,

Running Sewing Machines, Elevators, Printing Presses, Ventilating Fans, Blowers, Coffee Mills, Polishing and Grinding Tools, Etc.

New England Office, 14B High Street, Cor. Oliver, Boston.
Philadelphia Office, 301 Arch Street.

JOHN STEPHENSON CO.,

LIMITED,

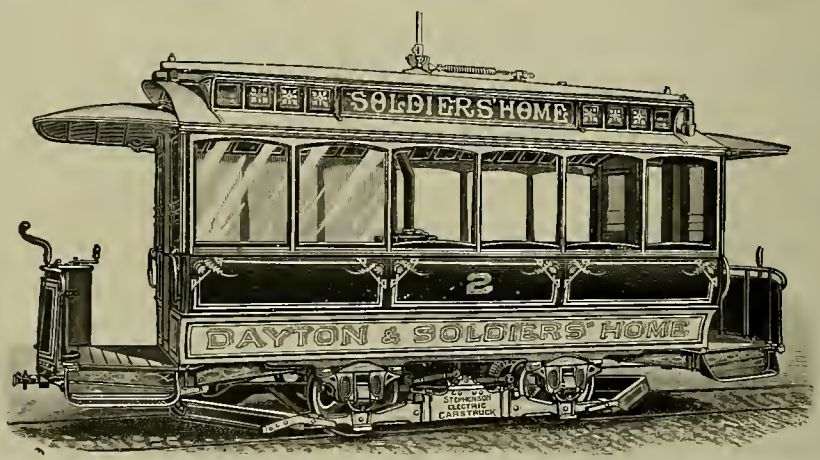
NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS

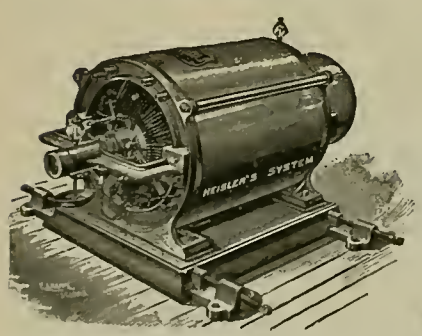
CARS ADAPTED TO ALL SYSTEMS.



THE HEISLER PATENT LONG DISTANCE

INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



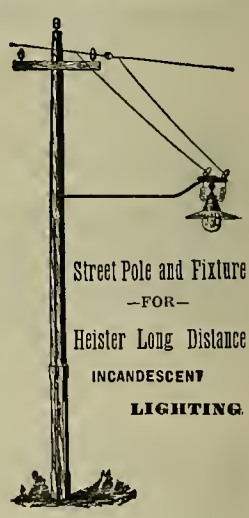
"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where Power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps, 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, · ST. LOUIS, MO.



Street Pole and Fixture

—FOR—

Heister Long Distance

INCANDESCENT

LIGHTING.

THE LEONARD & IZARD CO.,

CHICAGO.

GENERAL AGENTS "CENTRAL STATES DISTRICT."

(CASH INSTALLATIONS DIVISION.)

EDISON LIGHTING SYSTEMS.

EDISON Patented Devices, Including Bergman Fittings, Always in Stock.
EDISON Lamps, Regular Make, and to Fit any Socket.

Dealers in MISCELLANEOUS ELECTRICAL SUPPLIES.

All inquiries for EDISON DYNAMOS and EDISON PATENTED DEVICES in Ohio, Michigan, Kentucky, Tennessee, Indiana, Illinois, Wisconsin, Minnesota, Missouri and Kansas ("Central States District") should be addressed to

LEONARD & IZARD CO., · · Rialto Building, Chicago.

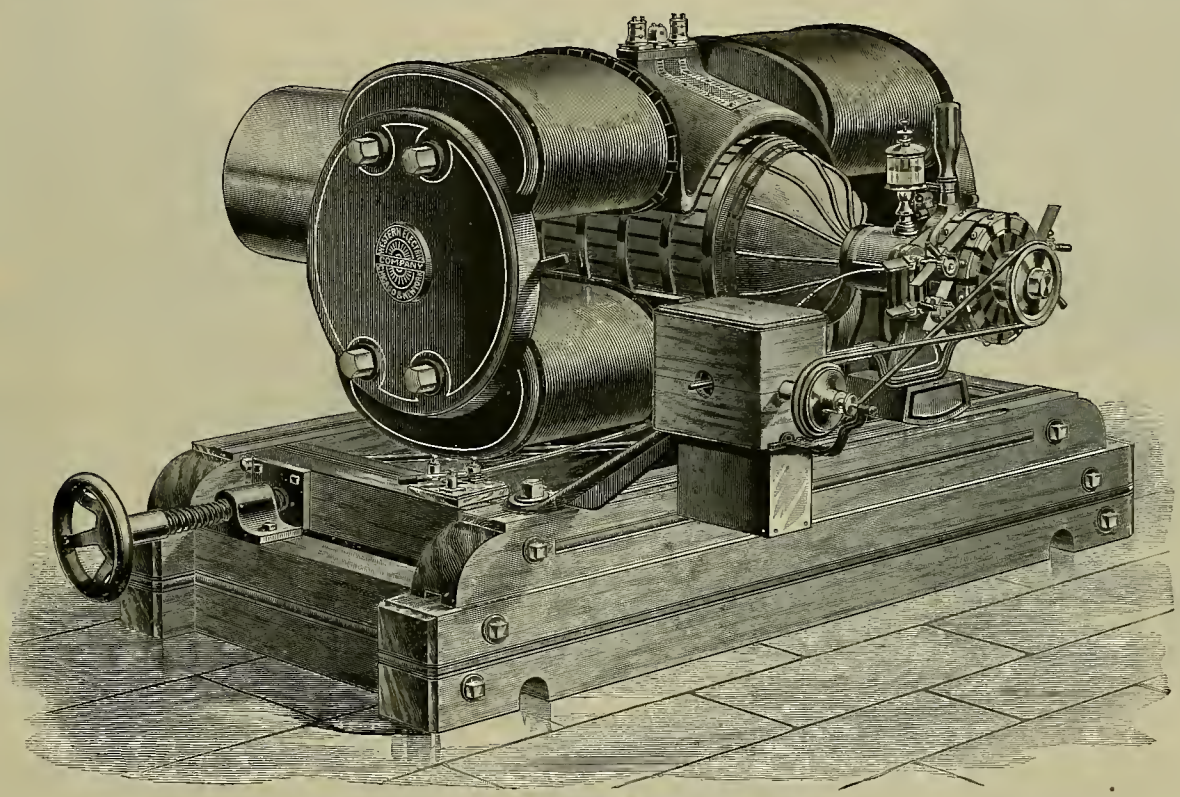
Western Electric Co.'s

ELECTRIC LIGHTING SYSTEMS.

DYNAMOS

WITH ALL NECESSARY APPURTENANCES.

INCANDESCENT. ARC, High or Low Tension.



HIGH TENSION ARC DYNAMO.

Arc Lamps, 2000, 1500, 1200 Candle Power.

HIGH OR LOW TENSION. SINGLE OR DOUBLE.

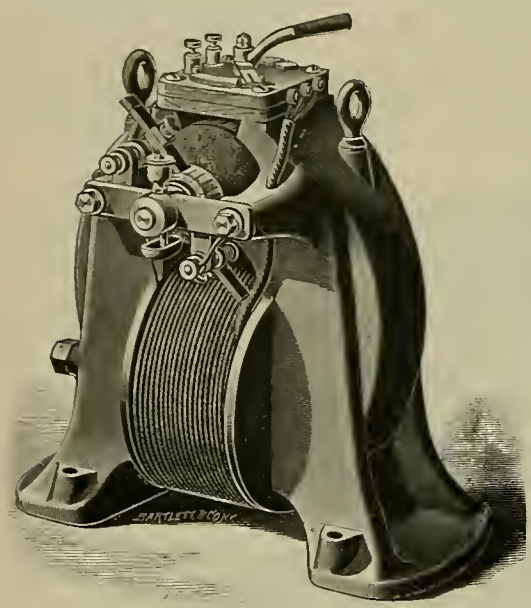
Simple in construction, economical in operation, and perfect in regulation. We are prepared to estimate on plants, either with or without power.

WESTERN ELECTRIC COMPANY,

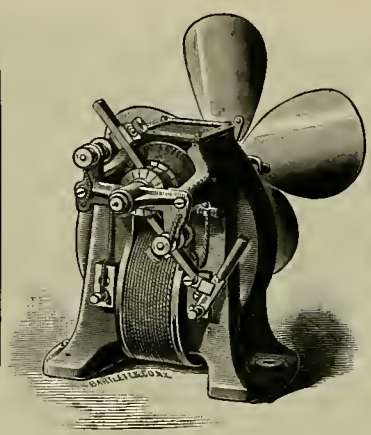
CHICAGO. NEW YORK. LONDON.

ANTWERP. BERLIN.

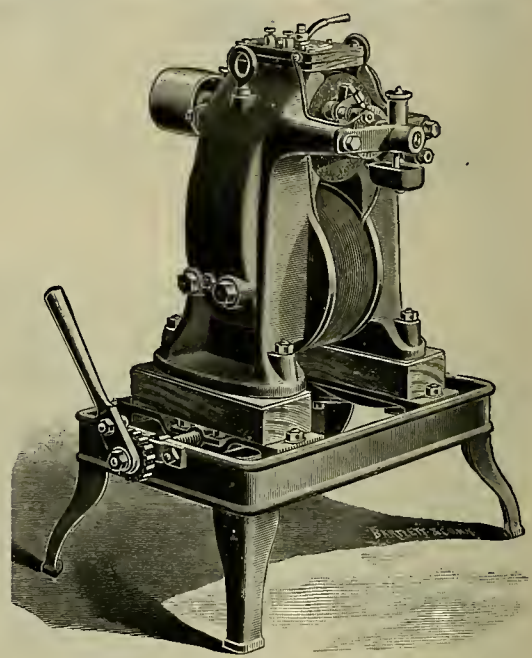
ELECTRIC MOTORS AND GENERATORS.



MOTOR WITHOUT BASE.



FAN MOTOR.



MOTOR WITH ADJUSTABLE BASE.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(WESTINGHOUSE ELECTRIC COMPANY, Lessees,)

EQUITABLE BUILDING, NEW YORK.

Manufacturers of Direct Current Generators and Motors for all purposes, from one-eighth horse power Fan Motor up to any size, and of any Electromotive force required.

Generators and Special Motors for Traveling Cranes, Elevators and Mining Purposes.

This Company will furnish apparatus of its own design, or will make Motors to Purchaser's Specifications for General Power Distribution, and for Electric Railway Cars.

The Special Form of Motor made by this Company is Superior in Design and Workmanship, and Unequaled in Efficiency.

CORRESPONDENCE SOLICITED.

ELECTRIC LIGHT PLANTS

INSTALLED

—IN—

Mills, Factories, Public Buildings, Hotels

THEATRES, ETC., ETC.

THE UNITED STATES

ELECTRIC LIGHTING COMPANY,

(WESTINGHOUE ELECTRIC COMPANY, Lessees)

More than One Thousand Plants in Operation.

CORRESPONDENCE SOLICITED.

OFFICES

Equitable Building, New York City.
Girard Building, Philadelphia, Pa.
"The Rookery," Chicago, Ill.
American Central Building, St. Louis, Mo
Mitchell Building, Cincinnati, Ohio.
328 Montgomery St., San Francisco, Cal.
Kamm Building, Portland, Oregon.
Dallas, Texas.
Charlotte, N. C.

FRAUD! FRAUD!

RECOGNIZING THE POPULARITY OF THE

SAWYER-MAN LAMPS,

UNSCRUPULOUS PERSONS MANUFACTURE LAMPS
IN BASES STAMPED

"SAWYER-MAN PATENTS."

THESE MANUFACTURERS BEING FINANCIALLY IRRESPONSIBLE

THE SAWYER-MAN ELECTRIC CO.

Hereby Gives Notice that it Will Enforce

THE STRINGENT LAWS

REGARDING FRAUDULENT PATENT-MARKS

AGAINST THE USERS OF SUCH LAMPS.

SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

THE

WESTINGHOUSE ELECTRIC COMPANY.

Arc and Incandescent Lighting

ON THE TRANSFORMER SYSTEM.

Manufactured under Patents of Stanley, Wallace and Others.

An experience of over two hundred sixty-five Central Stations has demonstrated the Converter System of Electric Lighting to be the only safe system.

The Converter of The Westinghouse Electric Company is so constructed as to absolutely prevent by any possibility a connection between the current of the street wires and the wires connected with the lamps on the premises.

The converter of this company reduces the potential of the primary wires and limits the quantity of current to the exact requirements.

It is the only system which admits of reliable meters.

There is not a single recorded instance of a connection between the primary and secondary circuits of this company's system.

Two hundred and sixty-five central stations in operation with a total dynamo capacity in sixteen candle power lamps of 458,250.

OVER 12,000 METERS IN USE.

Write for Particulars.

THE WESTINGHOUSE ELECTRIC CO.,

PITTSBURGH, PENN., U. S. A.

BOSTON, NEW YORK, CHICAGO, ST. LOUIS, CINNCINNATI. SAN FRANCISCO.
PORTLAND, CHARLOTTE, DALLAS.

SPRAGUE ELECTRIC RAILWAY SYSTEM.

The Pioneer of Successful Electric Railways.

The only Award given for Electric Railways at the Paris Exposition of 1889 was a GOLD MEDAL presented to the Sprague Electric Railway and Motor Company, for the most perfect system of Electric Railway Equipment.

What are the Essential Features in any Comprehensive Electric Railway System?

Main Feeders from Power Station.
Main Conductor Feeding in Trolley Wire.
Uniform Size of Trolley Wire, Independent of Length of Line, or Number of Cars Operated.

AND WHY?

BECAUSE, Thereby only can be secured **Uniform Electrical Pressure.**
Absolute Reliability of Service.
Non-interference with one section by interruptions upon any other.

The Sprague Company will guarantee to operate a ten mile Thirty Car, Double Track System with

Less Engine Power;
Less Dynamo Capacity;
Less Weight of Conductors;
Less Loss in Distribution;
Less Loss in Motors;

OR IN WORDS THAT ARE UNDERSTOOD BY ALL, WITH

More Car Miles per Ton of Coal Consumed;
More Miles of Line with a Given Loss;
More Territory Covered by a Given Outlay;
More Reserve Capacity in a Given Plant;

THAN CAN BE DONE WITH ANY OTHER SYSTEM.

FEATURES OF A CORRECT MECHANICAL DESIGN OWNED EXCLUSIVELY BY THE SPRAGUE CO:

Centering the Motor on the Driven Axle;
Flexible Yielding Support for Relief of Strains;
Universal Movement of the Trolley Pole;
Single Lever Movement for Motor Control;

NO COMPETITOR OF THE SPRAGUE COMPANY CAN MAKE A SIMILAR GUARANTEE, AND ACCOMPLISH IT TO THE LETTER.

SPRAGUE ELECTRIC RAILWAY & MOTOR COMPANY,

Nos. 16 and 18 Broad St., New York. - - Rialto Building, Chicago.

THE INTERIOR ELECTRICAL CONDUIT CO.

A New and Improved Method of Equipping Buildings with an Insulated Tube Conduit for any System of Electric Wiring.

COMBINING:

SAFETY—Absolute Immunity from electric fires.
ACCESSIBILITY—Perfect access to concealed wires.
ECONOMY—Small cost of installation, and freedom from future expense.
DURABILITY—Absolutely moisture-proof tube and appliances, insuring longevity of wires.
CONVENIENCE—Systems of electric wiring may be laid out on original plans in a manner similar to that employed for gas, water and steam piping; the conductors may be drawn in at pleasure.

FOR CIRCULARS, PRICE LIST AND INSTRUCTIONS, ADDRESS,

THE INTERIOR ELECTRICAL CONDUIT CO., - - - 154 AND 156 WEST 27TH ST., NEW YORK CITY.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

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Charles Munson Belting Co

MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

H. T. PAISTE,

—MANUFACTURER OF—

The Paiste Switches, Cut-Outs, Gas Attachments, Etc.,

HAS REMOVED

FROM 1206 CHESTNUT STREET,

—TO—

Twelfth and Market Sts.

PHILADELPHIA, PA.

USE THE BEST INSULATION.

The CELEBRATED **P. & B. ELECTRICAL COMPOUNDS.**

Thoroughly MOISTURE and WEATHER Proof, resist the STRONGEST ALKALIES, STRONG ACIDS, FUMES and GASES; also P. & B. WATERPROOF WRAPPING and INSULATING PAPERS.

We manufacture a special VARNISH for ARMATURES, and FIELD COILS.

The Standard Paint Co., 59 Maiden Lane, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. V. CHICAGO, FEBRUARY 22, 1890. No. 8.

Marsden J. Perry, President of the National Electric Light Association.

The accompanying portrait is that of Marsden J. Perry of Providence, R. I., who was elected president of the National Electric Light association at the convention at Kansas City last week. Mr. Perry is an enthusiastic member of the association. He has taken an active interest in the discussions, and has performed no little of routine work in the committees. He is a thorough believer in electric lighting as a business, and he is an ardent advocate of the best possible construction in central stations. Mr. Perry was born in Rehobeth, Mass., one of the oldest towns in the commonwealth, Nov. 2, 1849. On the site of this town his ancestors settled in 1641. He received his education in schools in the vicinity. At the age of twenty Mr. Perry located in Providence and soon after engaged in banking, with which business he is still identified under the original firm name of Perry & Co. In 1883 Mr. Perry purchased a controlling interest in the central electric light station in the neighboring city of Fall River, Mass. In November of the following year he had become so thoroughly convinced of the profitable character of electric lighting, that, notwithstanding the fact that the Fall River company was having a hard struggle,he bought a controlling interest in the Narragansett Electric Light company of Providence. Mr. Perry has frequently referred to the operation of that company, so that its station is familiar to the great majority of members of the National Electric Light association. He is vice-president and general manager of the company and president of the company in Fall River.

MARSDEN J. PERRY, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The Electric Limited Train to the Kansas City Convention.

Perhaps the finest train ever drawn out of Jersey City was that which carried the delegates of the National Electric Light association to Kansas City. A jolly party of over sixty persons occupied the cars. The coaches were lighted by electricity, and all the cars were heated by steam. The train consisted of a composite car, dining car, three sleepers, and an observation car. The party left Jersey City at 10:20 A. M. February 9th, and reached Chicago shortly after noon on the following day. The reception in honor of the delegates at the rooms of the Chicago Electric club is referred to under a separate heading. Two sleeping coaches and a second dining car were attached to the train at Chicago, and about 5 P. M. two C., B. & Q. engines drew the coaches out of the depot. The party passed a merry night on board. Early in the morning the reception committee from Kansas City boarded the train and extended a warm greeting to the party. On arriving at the depot the delegates found carriages in waiting, and were driven to their hotels.

The electric light plant on the "Electric Limited" consisted of an Eickemeyer dynamo and a Brotherhood engine which were located in the composite car; storage batteries of the New York Accumulator company's make were used in connection with the generating plant. Thirty-two cells were carried under each of the cars. The incandescent lamps gave a brilliant light and the electric light service was in every way satisfactory.

Chicago Electric Club Reception for the Electric Light Convention Delegates.

The Electric Limited train from New York, with the eastern delegates to the Kansas City convention, reached Chicago soon after noon, February 10th. A committee of the Chicago Electric club met the train ten miles before it reached the city, and extended a preliminary welcome to the delegates. Carriages were in waiting at the depot and the delegates were driven to the rooms of the Chicago Electric club. After an informal reception the delegates and club members gathered in the main hall. President F. G. Beach rapped for order. In a brief speech he extended to the visitors a cordial welcome to the rooms of the club. He was not, he said, authorized to bid them welcome to Chicago, but the executive officer, Mayor Cregier, was present and could speak for the municipality.

Mayor Cregier said in substance: "On behalf of the city of Chicago I am here to bid you thrice welcome. I have had occasion to visit the Chicago Electric club before, and if you are treated as I have been you will meet with the heartiest hospitality. I am sorry you are not going to stay longer, for the longer you stay in Chicago the more you like it. I am glad of this opportunity of addressing men who have done so much for electrical science. It is true that this science is still in its infancy, but when I look about this room and see the great number of young men here, I feel confident that even I will live to see a great advancement. I am glad to see so many friends from New York. I have no doubt you have brought with you the warrant for the World's Fair in Chicago in 1892."

Dr. Robert Amory of Boston was called upon for a response. He expressed his appreciation of the club's hospitality and assured the Chicagoans that if they ever should go to Boston they would be cordially received.

George M. Phelps of New York was called upon. Chicago and New York were, he said, near relatives. The eastern delegates found, that upon every visit they liked Chicago better; on each visit they received a heartier reception.

Dr. A. F. Mason of Boston, A. J. DeCamp of Philadelphia, F. E. Degenhardt, Chicago, and B. E. Sunny of Chicago, followed with short addresses.

Lunch was served by Kinsley, after which the informal reception was continued. A large number of club members and ladies were present, the parlors were thronged and the reception was in every respect successful. One of the ornaments of the hall was a large star formed of incandescent lamps in the center of which had been placed an array of flowers. During the reception a mandolin orchestra furnished music.

The party left the club rooms about 4:30 for the depot. They were accompanied by many Chicagoans who bade the delegates God speed as the special train pulled out of the depot.

THE CONVENTION

Of the National Electric Light Association at Kansas City.

The eleventh convention of the National Electric Light association was held at Kansas City, Mo., February 11th, 12th, 13th and 14th. The sessions were held in Coates Opera house. Following is a list of the members and guests in attendance:

MEMBERS AND GUESTS.

Alexander, P. H.....New York.
Acevedo, E. M.....Buenos Ayres, Argentine Republic.
Amory, Dr. Robert.....Brookline, Mass.
Andrae, Henry.....Milwaukee.
Armstrong, E. A.....Camden, N. Y.
Armstrong, C. G.....Chicago, Ill.
Aitkin, J. H.....Pine Bluff, Ark.
Atkinson, George.....Chicago, Ill.
Austin G. L.....Boston.
Bates, Maurice E.....Kansas City.
Baird, M. E.....Windsor, Conn.
Benton, Charles A.....New York.
Barker, F. E.....Boston.
Brophy, William.....Boston.
Brady, T. H.....New Britain, Conn.
Bowman, J. H.....Peoria, Ill.
Boyd, S. A.....Indianapolis
Badger, S. S.....Chicago
Bair, L. C.....Kansas City.
Baird, S. P.....St. Louis, Mo.
Barton, S. E.....Boston.
Baker, Cyrus O., Jr.....Newark, N. J.
Bossart, P. W.....Kansas City.
Bauer, A. H.....Chicago
Beebe, L. A.....Hutchinson, Kan.
Bailey, G. C.....Chicago.
Baugher, F. W.....St. Louis
Bell, C. C.....Booneville, Mo.
Bridgeman, J. C.....Wilkesbarre.
Burns, P. C.....St. Louis.
Buckley, W. J.....Chicago.
Browne, R. H.....Fort Smith, Ark.
Clower, D. M.....Dallas, Tex.
Candee, W. L.....New York.
Cooke, E. J.....Brooklyn.
Caldwell, Ford S.....Kansas City.
Conant, Henry J.....Boston.
Crouse, J. B.....Cleveland.
Cushing, F. W.....Chicago.
Cooley, J. A.....St. Louis.
Chisholm, J. H.....Atchison, Kan.
Carrier, A. E.....Pittsburg.
Clohesy, T. F.....Kansas City.
Cone, C. H.....Chicago.
Campbell, J. A.....Detroit
Cherry, E. V.....Cincinnati.
Cole, Lafayette.....Peoria.
Chalmers, David.....New York.
Cutter George.....Chicago.
Clower, Walter M.....Dallas, Tex.
Cutler, H. M.....Kansas City.
Clark, E. L.....Chicago.
Cavell, E. V.....Chicago
Cloud, A. L.....Chicago.
Chick, J. S.....Kansas City.
Cruse, J. D.....Kansas City.
Chadwick, T. A.....St. Joseph, Mo.
Costello, F. E.....St. Louis
Coles, C. F.....Brooklyn, N. Y.
Chambers, D. W.....New York.
Cuddihy, C. D.....Red Jacket, Mich
Corby, Jas. A.....St. Joseph, Mo.
De Camp, A. J.....Philadelphia.
Ditsch, O. W.....Kansas City.
Davenport, J. J.....Kaosas City.
Darrah, J. B.....McPherson, Kan.
Davis, C. M.....Pueblo, Colo.
Durborow, A. C. Jr.....Chicago.
Dean, D. B.....Chicago.
Degenhardt, F. E.....Chicago.
Dee, J. R.....Houghton, Mich.
Daniels, J. T.....Houghton, Mich.
De Land, Fred.....Chicago.
Dickerson, J. W.....Chicago.
Dean, Frank M.....Jacksonville, Ill.
Daniels, A. L.....North East, Pa.
Dennison, E. W.....Omaha.
Dyer, I. T.....St Joseph, Mo.
Dyer, H. W., Jr.....St Joseph, Mo
English, C. C.....Kansas City.
English, T. F.....Kansas City.
Everts, D. T.....Chicago.
Evans, D. E.....Baltimore.
Elmore, Guy H.....Kansas City.
Emery, C. W.....Chicago.
Everingham, J. J.....Kansas City.
Fay, Wm.....Fort Wayne.
Field, C. R.....New York.
Francisco, M. J.....Rutland, Vt.
Faben, C. R.....Toledo, O.
Floyd, Edwin.....Chicago.
Fishback, L. M.....St. Louis.
Faunce, A. B.....Quincy, Ill.
Flanders, D. J.....Brooklyn.
Friend, H. W.....Vincennes, Ind.
Foote, Allen R.....Washington, D. C.
Greenfield, Edwin T.....New York.
Godfrey, James W.....New York.
Garver, M. M.....Newark, N. J.
Garratt, A. V.....New York.
Geer, D. S.....Chicago.
Glasier, H. A.....Chicago.
Grimes, W. B.....Kansas City.
Gregory, C. E.....Chicago.
Gray, M. J.....New York.
Grimes, W. B., Jr.....Kansas City.
Hubbell, Ira C.....Kansas City.
Halsted, J. B.....New York.
Hood, William R.....Philadelphia.
Hartwell, M. N.....Providence, R. I.
Hatch, E. B.....Hartford, Conn.
Hart, G. W.....Kansas City.
Harber, C. A.....Kansas City.
Hammond, Dr. Wm. M.....Kansas City.
Hoefer, Ernest.....Chicago.
Holmes, C. H.....St. Louis.
Hayes, Webb C.....Cleveland.
Huntley, C. R.....Buffalo.
Haskins, C.C.....Chicago.
Hazletine, C. W.....St. Louis.
Hamacher, J. R.....Richmond, Mo.
Hobart, G. C.....Cincinnati.
Hewes, Geo. T.....Chicago.
Hoover, F. K.....Kansas City.
Holtzinger, F. K.....Kansas City.
Hartwell, M. H.....Providence, R. I.
Hohle, G. M.....St Joseph, Mo.
Heller, H. E.....Allentown, Pa
Hinrichs, V.....Carroll, Iowa.
Ide, A. L.....Springfield, Ill.
Irvine, A.....St Louis
Jenkins, L. S.....Kansas City.
Johnson, Edward H.....New York.
Johnston, W. G.....New York.
Johnson, W. T.....Louisiana, Mo.
Jenney, Charles D.....Indianapolis.
Jones W. H.....Cincinnati, O.
Knight, Frank E.....Meriden, Conn.
Keller, Henry E.....Allentown, Pa.
Kahn, Emil.....Cincinnati
Kelly, James F.....Schenectady.
Kunz, Louis.....Kansas City.
Killcutt, S. D.....Boston.
Kelly, W. S.....New York.
Kammeyer, C.....Eau Claire, Wis.
Kreidler, W. A.....Chicago.
Kohler, G. A. E.....Chicago.
Kempt, Alex.....Chicago.
Kay, E. B.....Excelsior Springs, Mo.
Kingman, Martin.....Peoria, Ill.
Lacey, J. W.....Carrollton, Mo.
Law, M. D.....Philadelphia.
La Salle, Edward.....Kansas City.
Leooard, H. Ward.....New York.
Lockwood, H. T.....Chicago.
Lawrence, W. H.....Cleveland.
Lucas, H. P.....Chicago.
Lockwood, J. E.....Detroit.
Lowe, W. W.....Chicago.
Leonard, S. S.....Chicago.
Lufkin, H. L.....New York.
Morse, A. M.....Kansas City.
Manson, George T.....New York.
Meyer, George.....Kansas City.
Mason, Dr. A. F.....Boston.
McKinlock, W. H.....Chicago.
Mead, Morris W.....Pittsburg.
McQuaide, J. P.....New York.
Miles, Benj. F.....Cleveland.
Munsie, J. F.....Brooklyn
Mitchell, H. S.....Fort Scott, Kan.
McDaniel, C. W.....Kansas City.
Macmillan, A.....Kansas City.
Mason, J. W.....Kansas City.
Newton, A. D.....Windsor, Conn.
Newton, C. E.....Hartford, Conn.
Osborn, W. T.....Kansas City.
Oldfield, W. G.....Newton, Kan.
O'Neil, J. W.....Wichita, Kan.
Palmer, H.....Chicago.
Parsons, E. M.....Carroll, Iowa.
Pike, E. W.....Salina, Kan.
Patterson, A. H.....New York,
Porter, George F.....Philadelphia.
Peck, E. F.....Brooklyn.
Phelps, George M.....New York.
Platt, Floyd.....Kansas City.
Pentz, James A.....Philadelphia.
Perry, Marsden J.....Providence.
Price, Charles W.....New York.
Pearson, W. B.....Chicago.
Powers, E. A.....Chicago.
Page, A. K.....Boston.
Porter, M. S.....Kansas City.
Parker, G. W.....St. Louis.
Pyle, G. C.....Indianapolis
Parker, J. H.....St. Joseph, Mo.
Pond, F. H.....St. Louis, Mo.
Reynolds, T. H.....Kansas City.
Ross, C. A.....Kansas City
Reed, E. M.....Wichita, Kan.
Rogers, Frank A.....Cleveland, O.
Ransom, C. M.....Boston.
Royce, F. W.....Washington D.C.
Russell, D. R.....St. Louis.
Rusling, C. H.....Kansas City.
Ritchie, John.....Chicago.
Reichle, F. W.....Buffalo.
Rose, P. C.....St. Louis.
Richmond, C. T.....Fremont, O.
Rusling, F. D.....St. Joseph, Mo.
Rohinson, A. A.....Detroit.
Rosamond, S. J.....Kansas City.
Sprague, F. J.....New York.
Stedman, J. H.....Chicago.
Steiringer, Luther.....New York.
Stump, Clarence E.....New York.
Shoemaker, I. H.....Philadelphia.
Sprague, C. H.....Kansas City.
Sweatland, H. M.....New York.
Steley, John A.....New York.
Smith, J. M.....Topeka.
Smith, T. Carpenter.....Philadelphia.
Stanley, H. D.....Bridgeport, Conn.
Schieren, C. A., Jr.....New York.
Smith, Gilbert M.....Chicago.
Smith, Wiley W.....Kansas City.
Sanborn, B. D.....Greeley, Colo.
Schmidt, B. H.....Chicago.
Schramm, O. H.....St. Louis.
Shay, J. H.....St. Louis.
Smith, A. E.....Chicago.
Scammon, James.....Kansas City.
Sargent, W. F.....Kansas City.
Smith, D. K.....Kansas City.
Smith, B. W.....Milwaukee.
Seymour, A. P.....Syracuse.
Shultz, J. A. J.....St. Louis.
Smith, J. M.....Topeka.
Swetland, H. M.....New York.
Tobey, George A.....New York.
Thompson, N. C.....Fort Scott, Kan.
Terry, F. S.....Chicago.
Tudor, H. C.....Baltimore.
Taltavall, J. V.....New York.
Tallmadge, C. H.....Kansas City.
White, J. G.....Kearney, Neb.
Wells, W. W.....Atchison, Kan.
Wolf, Thomas.....Kansas City
Willvoung, E. G.....Philadelphia.
Woodruff, H. O.....Des Moines.
Walker, W. B.....Leavenworth, Kan.
Walton, F. T.....Philadelphia.
Western, Benjamin A.....New York.
Wyman, F. A.....Bridgewater, Mass.
Wheeler, S. S.....New York.
William, E. G.....Philadelphia.
Watt, Robert.....Brooklyn.
Weeks, E. R.....Kansas City.
Walburn, A. W.....Fort Scott, Kan.
Whipple, Fred H.....Detroit.
Wilmerding, C. H.....Chicago.
Wilson, T. J.....St. Louis.
Woodring, W. H.....Kansas City.
Young, John.....Chicago.
Yenawine, W. H.....St Joseph, Mo.
Yost, L. M.....Hayes City, Kan.
Yenawine, F. P.....St Joseph, Mo.

Tuesday's Proceedings.

The convention was called to order about 1 o'clock by President E. R. Weeks. About 150 members of the association and guests were present. Over the stage of the opera house was suspended a frame in which were arranged red, white and blue incandescent lamps representing the formula $C = \frac{E}{R}$. The design was striking and the effect was brilliant. President Weeks introduced the mayor of Kansas City, J. J. Davenport, who delivered the following address of welcome:

MAYOR DAVENPORT'S ADDRESS OF WELCOME.

To me has been assigned the pleasant and agreeable duty of welcoming you to our city, where many of the most important and interesting conventions that have been held throughout the United States during the year of 18 9 and '90 have sat in deliberation. To none, however, have I extended in behalf of our citizens, a more cordial and heartfelt greeting than it is now my pleasure and privilege to offer you, whose coming has been a source of pleasant anticipation, mingled perhaps, with the hope that here in the center of this great American Union, the verge or margin of that border land of science, which Mr. Thurston so graphically depicts, may some day find its beginning, a land, where it is said, the portrait of the sender of each telegraph dispatch will accompany the message, where sub-marine and aerial navigation will be carried on successfully by the power derived from stored electricity; where the soft light of the fire-fly or glow-worm will be produced by man, and the direct conversion of heat into electricity will be solved. The result of your deliberations will be anxiously awaited by the whole commercial world, as well as the scientific, because electricity has given an impetus to the former, that has driven and impelled it forward with wonderful rapidity and signal success to its present high state of perfection. Its civilizing influences have extended the confines of education, refinement and culture, to the uttermost part of the earth. You, gentlemen, are the exponents of laws which govern one of the most powerful forces of nature, under the action of which energy becomes appreciable. You teach us that like heat, light or work, it is measurable and can be produced, or converted into other forms of energy. By means of this marvelous agency you have already presented to science most wonderful aids by which she has been able to make visible what has hitherto been invisible, to make audible what has been inaudible, and to discover what has not been dreamed of in the philosophy of mankind, for whether its manifestations be considered under the head of static, galvanic or faradic, it is all electricity—it is all witchcraft with its future possibilities entirely inconceivable, except to such research as may result from distinguished and able gentlemen such as compose this assembly. As we hear of these mysterious currents measured in amperes, and of the power by which various bodies resist these currents measured in ohms, we seem to be attaining the condition of life of which Mr. Thurston speaks, or that so cleverly protrayed by Bulwer in his "Coming Race," in which all are happy and har-

monious, seeming to have reached the millennium, evil being held in bondage by the potent "Vril" wand, which gives to all alike motive, defensive and creative power, with also the perfect knowledge of how to use it for the greatest and best good of all. Electricity is our magic "Vril" wand and you are teaching us its capabilities. Six years ago it had not been used upon the broad ocean, that difficult and dangerous field of warfare. When the Navy department fitted out the frigate Trenton, with an electric incandescent plant, the eyes of the world were upon her, eager to see the mooted question settled as to how the glass bulbs and carbon filaments would bear the firing of the frigate's guns. The three years' successful cruise proved so much to the United States and to those foreign countries who are learning to follow in her footsteps that now a man-of-war is not equipped without the incandescent lighting plant, and the "arc" for the search light, which reveals not only the dangers of the surface of the mighty ocean, but pierces her briny deeps, detecting death-dealing torpedoes that have been laid for destruction. This faithful servant of man, now not only guards the vessel from the inventions of the enemy, but aims and fires the guns, illuminates the sights that the aim may be sure, discharges torpedoes, measures her speed, is the most successful motor for submarine boats, and renders possible a system of visible telegraphy by which communications may be flashed against the clouds and understood at a distance of sixty miles. We welcome you as true benefactors of mankind, the emancipators of the human race from darkness. What you and those of your profession have accomplished within the past years, reflects credit upon your country, borders close upon the miraculous, and entitles you to imperishable honor and renown. I will not detain you in enumerating your achievements, gained by the most faithful and unremitting labor. Cost, or dollars and cents is the great obstacle in the way of the speedy and universal adoption of many of your most important discoveries and perfected inventions. Electricity to-day is at its highest cost, and we look forward to the time when, being cheaper, it will accomplish for humanity all that it now promises. It is estimated that at the beginning of the year 1890, $600,000,000 was invested in the electrical industry in the United States, and that 250,000 persons depended upon it for their means of living; that a million miles of telegraph wires were in operation, enough, it is said, to encircle the globe forty times; 300,000 telephones were constantly talking, and an average of 1,055,000 messages were sent daily, requiring the use of 170,000 miles of wire. The longest distance over which conversation is maintained is 750 miles, from Portland, Me., to Buffalo, N. Y. Just how many of the musical kind are in use, that Mr. Bellamy speaks of, I do not know. Four hundred miles of electric railway are in active operation in America. The fastest speed attained in the transportation of passengers has been 20 miles an hour. I believe Mr. Weems has quite recently at Laurel, Md., upon an experimental track, made 2 miles a minute or 120 miles per hour. There were no passengers upon that train, however, it being used exclusively for baggage, which is hereafter to be sent in advance. At your annual meeting at Niagara Falls, the statement was made that there were in use in the United States 237,017 arc lamps and 2,704,768 incandescent. I hope that the increase will be so great within the next few years that the various companies will find it possible to furnish light and motive power at much lower rates. Electric light is certainly the only form of artificial illumination not injurious to health, and therefore it is our hope that all classes may soon, in consequence of its cheapness, be enabled to enjoy its benefits. The mystery which seemingly surrounds electric service will in time be dissipated, and it will come to be regarded with less suspicion and fear. Perfection cannot be expected in the use and distribution of such force and power immediately. Danger to human life and property interests are questions in which we are all concerned, but it will not do to condemn without comparison and investigation, else we may deprive ourselves of valuable agencies and servants, when to understand is to bring us health, wealth and prosperity. Immense poles, that make unsightly our most beautiful thoroughfares, over which hang a dense mass of wires to obstruct access to our buildings in case of fire, and almost shut out the light of day, will in time disappear. It was necessary that they should precede the subways now coming into use, but not yet, I believe, admitted to be universally successful, though the Bell Telephone company had in 1887 6,030 miles of wire underground; in 1888, 8,009, and in 1889 had increased it to 17,038 miles. Taking into consideration, however, the service performed and work done through the means of this unseen power, it is pleasing to note that the casualties resulting from its use are less than from any other service.

To the future we can only look with wondering eyes and bated breath, and to you as the workers of miracles. May your deliberations, gentlemen, while here, be as harmonious as the laws which govern the marvelous and wonderful philosophy of electricity.

PRESIDENT WEEKS' ANNUAL ADDRESS.

President Weeks made his annual address as follows:

At our first convention, held in February, 1885, there were eighty-seven delegates, full of enthusiasm for the good to be accomplished. I believe, gentlemen, that they have not been disappointed in the work of this association. As one of the original eighty-seven, I point with pride to five years of broadening and harmonizing influence; and I believe that every central station, every factory, every supply company in the country has felt its impulse toward improvement.

To-day, gentlemen, we number 304, representing not only a wider extent of territory than ever before, but all the leading systems of the United States. A more fraternal spirit now prevails between the electric light and power men and our elder brothers of the telegraph and telephone interests, a pleasant proof of which has been given by the hearty co-operation of their representatives in this city, in preparing for the entertainment of the convention.

The past work of the association speaks for itself; but our number has so increased, and our sphere of usefulness has so advanced, that we must look for work of a better character than was possible in earlier days, when most of our members were new to the duties which they had undertaken. We now need work of more direct practical value to central station men, and theoretical work of a higher grade than that of the past, good as that has been. With this in view, we have endeavored to prepare a programme of such importance both practically and theoretically that you will find it good to be here.

The committee on state and municipal legislation will report the organization of state associations with a view to developing among legislators a full appreciation of the importance and needs of the electrical industries, and to present these industries in their true light. The urgent need is for organization along the lines of legislation and popular education. This can be best accomplished by state associations, whose conventions could advantageously take the place of the semi-annual meetings of this association. Ten of these state associations have been formed, and I hope that before the close of this convention steps will be taken toward the organization of many more.

The increasing interest in railroad work and the immense field for future development in the motor department will render especially pertinent the discussion by Mr. Sprague, and also the work of the committee on standardization of potential on electric street railways, the report of which will be submitted through its chairman, Mr. Lynch.

As the growth of our industry must be chiefly in the direction of incandescent light and power, the discussion to be presented by Mr Field is of the greatest importance both to central station men, and to all who desire electric service in their homes.

The watchwords of the future are certainly economy of fuel, and perfect insulation, and, while there may be improvements in designs for apparatus and in methods and means of distribution, and while we still hope for the direct conversion of the energy of coal, the advance of the immediate future should be in the direction of economizing present waste, rather than in the discovery of new facts or priociples. Americans are proverbially prodigal, and there is an absolute and growing need that waste and loss should be arrested. While the demand for the necessary elements is increasing with the population, the supply of many of those elements is steadily diminishing. Messrs. Babcock and Sickles will doubtless point out lines of economy in the department of steam engineering, and Mr. Smith will present for our consideration another phase of the same question, 'A Universal System of Central Station Accounts." The many problems arising in the electrical and mechanical departments of the operation of central stations have left this question to general neglect. But now that we are becoming passably familiar with the tricks of our apparatus, attention is more and more directed to data for comparison, with a view to economic methods.

The topic of the hour is certainly safety. It would seem that in view of the relatively small number of serious accidents connected with electrical industries, we have grounds for some impatience with the present outcry against electricity as a dangerous servant. It is true that compared with those which have accompanied the introduction and use of steam and gas, the number of accidents in the use of electrical apparatus is very small. But in this age, comparative rates will not be accepted as answers; the people have a right to demand that devices for public safety keep pace with development in other directions. The discussions of Prof. Thomson and Messrs. Haskins and Harber will present this current topic in its various phases. I trust that each speaker will enforce the importance of good construction and maintenance, on the part of producers; and proper inspection on the part of the municipality.

It is hoped that the committee on "Underground Conduits and Conductors" will be able to report some facts regarding the actual operation of high pressure currents underground. Thus far, discussion of this topic abounds in theory and speculation, but contains little experience.

During the past twelve months, there has not only been a greatly increased activity in the electrical industries abroad, but many millions of foreign money have been invested in the electrical properties of America. It is also worthy of note that our brethren in Great Britain have set the example of adjusting differences amicably, instead of carrying litigation to the court of last resort. Such a policy in America would not only have saved hundreds of thousands of dollars now charged to profit and loss; but would have greatly enhanced the value of electrical securities.

The past year has furnished instances in which the value of local electrical properties has been greatly depreciated through the invasions of territory already fully occupied. This policy is shortsighted. Prices in most cities, are fair and just, both to consumer and producer. To depreciate them, will not only ruin the business of pioneer companies who have invested large sums, and borne the brunt of introducing a new and valuable industry, but cannot fail to result in great loss to the invader.

Although electric lighting in this country has seemed to receive a check, a look ahead would not be discouraging. The law that "action and reaction are equal and in opposite directions" applies not only to mechanics, but to public opinion. As America is the birthplace of the commercially successful electric light; and as Americans are the foremost people of the world to recognize improvements; we may well believe that with proper attention on our part to our duties to the public, the present popular and largely sensational agitation against us will give place to a feeling of confidence. In the meantime, let the outcry teach its proper lesson to all engaged in the electrical business.

Secretary Garratt presented this report as treasurer:

TREASURER'S REPORT.

Balance from account rendered July 31, 1889, at Niagara Falls.		$1,096 93
Dues from 51 members		1,020 00
Total		$2,116 93
Expenditures as per accompanying vouchers		$1,506 66
Balance, cash on hand Dec. 31, 1889		610 17
Total		$2,116 93
The indebtedness of the association is an unpaid bill of		$ 259 60
The total receipts for the year 1889 have been, including the balance from the previous account.	$5,845 55	
Total expenses for year of 1889		$5,235 38
Balance, cash on hand Dec. 31, 1889		610 17
Total		$5,845 55
The expenditures of the year 1889, may be classified as follows:		
Old bills incurred previous to 1889		$1,483 82
Salary of Secretary and Treasurer, 12 months		1,999 92
Clerk hire		40 00
Postage		176 48
Printing and stationery		712 19
Official stenographic reports		246 62
Rent of office		207 50
Advertising in Electrical Journals.		101 99
National Committee on State and Municipal Legislation		98 65
Not otherwise specified above		168 21
Total		$5,235 38
The net income for 1889 was	$5,545 82	
The running expenses for 1889 were		3,751 56
Excess of net income over running expenses		1,794 26
Total		$5,545 82

Membership.

Total number of members Jan. 31, 1889	251
Members added between Jan. 31 and Dec. 31, 1889	21
Total	272
Members resigned between Jan. 31 and Dec. 31, 1889	13
Making a total membership Dec. 31, 1889	259

Secretary Garratt read a communication from the Commercial club of Kansas City, tendering the delegates a reception. The courtesy of the Commercial club was accepted with a vote of thanks. A communication from W. H. Briethaupt, president of the Engineers' club of Kansas City, was read, tendering the privileges of the club room to the National Electric Light association during the convention. A communication from J. H. Veitch, general agent of the Chicago, Milwaukee & St. Paul railway, was presented, extending an invitation to the members of the association to visit Excelsior Springs, and offering a special train for that purpose on Wednesday, the 12th. A communication from Howard M. Holden, president of the Excelsior Springs company, extending an invitation to the same effect, was also read. The secretary also read a communication from W. Wiley Smith, secretary and superintendent of the Missouri & Kansas Telephone company of Kansas City, extending congratulations to the association, and offering telephonic facilities between the halls and the central office, and also extending to the delegates an invitation to visit the central office of the Telephone company, in which, as was stated, nearly 2,600 wires were handled in one room, and over 32,000 calls per day were made. The invitations were accepted with thanks.

Invitations to visit the National Military Home and to attend a reception to be held at the Warder Grand Opera house on Friday evening, were referred to the executive committee.

F. E. Degenbardt, W. L. Candee and Secretary Garratt were appointed a committee to prepare resolutions upon the death of C. McIntire and Miles W. Goodyear.

The convention adjourned to 9 o'clock Wednesday morning.

Wednesday Morning's Proceedings.

The convention was called to order in Music Hall at 9 A. M., President Weeks in the chair. Secretary Garratt read a communication from R. J. McCarty, manager of the Metropolitan Street Railway company of Kansas City, extending to the members of the association the privilege of riding free over its lines. The company also invited the members to take a trip over the Armourdale electric line. The invitations were accepted.

A communication from the Missouri State Association of Architects in session in Kansas City was presented, extending to the members of the Electric Light association the courtesies of Missouri State Association of Architects, and inviting them to inspect the exhibit of architectural drawings. The invitation was referred to the executive committee.

PRESIDENT WEEKS: The first thing on the program this morning will be the report of the committee for the abolition of customs duty on copper, which will be presented by George M. Phelps of New York.

REPORT OF COMMITTEE ON COPPER.

G. M. PHELPS: The committee appointed at the last meeting of the National Electric Light association to petition the proper committee of Congress for the abolition of duty on copper, appeared at Washington January 16th, through Mr. Phelps, who presented the following petition to the Committee on Ways and Means with the subjoined address:

Petition to the Honorable Committee on Ways and Means, House of Representatives, U. S. A.: The subscribers were appointed a committee to petition your honorable body for the abolition of duty on copper ingot, plate bars, rod and wire. We represent the National Electric Light association, a body composed of representatives of electric lighting companies throughout the United States, and also manufacturers of and dealers in electric lighting apparatus and supplies. The resolution appointing this committee was passed without a dissenting vote. We, therefore, have the honor to present this petition, earnestly requesting that the action asked to be taken as a measure, will be approved by the great body of users and manufacturers of copper.

CHARLES A. BROWN,
GEORGE M. PHELPS,
J. F. MORRISON.

The National Electric Light association consists of corporations, firms and individuals, owning and operating stations and plants for the distribution of power by electricity. At the time of the last convention of the association, Aug. 6, 1889, the capital then invested in the industries above named was estimated, from statistics collected by the secretary of the association, to be not less than $275,000,000 This sum represented mainly electrical apparatus and electric conductors for the supply of 238,000 arc lamps and 2,700,000 incandescent lamps, in all which apparatus and conductors, copper is an indispensable and chief material. In the total cost of electric plant for light and power distribution, it is estimated, by competent experts, that from one-fourth to one-third is expended for copper. The foregoing figures and statements sufficiently indicate the magnitude of the interest of electric light and power companies in the price of copper. In the opinion of the petitioners the proposed abolition of the copper tariff does not touch the question of protection to American industry. The duty on copper appears to be wholly superfluous as a protection to American producers of that metal, the United States not only produces more copper than it consumes, and consequently exports that metal, but it possesses the richest and most easily worked copper mines in the world, and its mining companies produce the metal and put it in the market at a lower cost than is possible to the Spanish or Chilian miners. Obviously the American producers of copper require no duty to protect their domestic market, and their exports of copper furnish sufficient evidence of their ability to meet competition in foreign markets. The existing duty is of no appreciable value to the national treasury, because copper is not imported in any considerable quantity. As a source of national revenue the copper tariff is practically useless, and the returns from it could not be increased materially under the conditions of production throughout the world by any modification of the rate of duty, if the government needed increased revenue, which it confessedly does not.

It would appear, therefore, that the duty on copper can only be efficient in enabling the mining companies and dealers in copper to establish and maintain excessive prices through combination for that purpose. It is believed that the United States duty of four cents per pound was a considerable factor in the operations of the syndicate, established in France in the autumn of 1887, and which syndicate, aided by its agreements and contracts with copper mining companies in this country, succeeded in controlling the copper production and markets of the world for more than a year, doubling, for a considerable period, in London and New York, the price existing just previous to the beginning of its operations. This was effected, moreover, in the face of an abundant supply of the metal. For some months after the break-down of the French speculation, the American companies maintained the price in this country considerably in excess of that of European markets.

Touching the relation of the duty on copper to combinations for maintaining excessive prices, the following quotation is subjoined from an editorial in the New York *Tribune*, May 15, 1889:

"The mine owners have publicly stated that they are able to produce more than all the copper this country consumes, and a large part of it at a cost not exceeding 6 cents per pound, and that they propose to the French bankers, who hold an enormous unsold stock to fix the selling price at about 13 cents per pound—more than double the cost. Nothing need be said about the right of the producer to get a profit of more than a 100 per cent. on his copper, provided he is not a beneficiary of a national policy intended to protect and encourage American productions. But the mine owners are beneficiaries of that policy, and owe to the public a certain consideration and service in return. If they enter into a combination for the benefit of foreign speculators and bankers against the interests of American producers, the duty on copper may not last long. . . There will in all probability be a revision of the tariff next winter. The party in power being anxious to defend all industries that need and merit defense, appears to be needed or where it seems to be deserved. Combinations of speculators to corner the markets of the world are not highly popular, and will not appear to members of Congress to merit particularly favorable consideration. Under such circumstances the demand for a removal of all duties on copper ore, pig and bars, will be difficult to resist. It is safe to say that, had the Mills bill proposed no change more unpopular or unobjectionable than that, its public support would have been incomparably greater."

In short, and to recapitulate, in the opening of the National Electric Light association the duty on copper, being useless for revenue and unnecessary for protection, should not be suffered to remain on the statute book of the United States, since its only remaining function is to serve as an ally to the promoters of combinations for putting up prices, a process to which the government should not lend its assistance.

The committee has circulated an auxiliary in support of the petition presented in behalf of the association. It has been intended to solicit the signatures of all companies, firms or individuals engaged in electrical industry, and to offer opportunity for signing to all other persons accessible to the committee who are in sympathy with the proposed measure. On the 8th of February 440 signatures to such auxiliary petitions were forwarded to the Committee on Ways and Means of the House of Representatives. Your committee are still engaged in circulating copies of the auxiliary petition, and hope to collect several hundred more signatures. The committee would earnestly request any members of the association or others inclined to sign the petition, who have not received a copy, to address either members of the committee, *viz:* Chas. A. Brown, 227 South Clinton street, Chicago; Geo. M. Phelps, 150 Broadway, New York; J. F. Morrisoo, 15 South street, Baltimore.

I wish to suggest further that members who feel deeply interested in this matter would, I think contribute to the success of the petition, by addressing communications to their several representatives in the national congress. It is somewhat problematical I think, whether any discussion of the subject or revenue at all will be permitted to take place on the floors of congress this session. But, if such a discussion can be brought about there, it is the opinion of your committee that the success of their petition is exceedingly probable. There is practically nothing to be said in favor of retaining the duties on copper. I have not heard a word in defense of it: The only persons who have been at all d sinclined to sign the petition, have been those who have said substantially, "Yes it is all right; the duty on copper ought to go, but we make something else, and our friends make sometbing else that are protected by tariff duties, and we do not want this thing stirred up." We feel that the greatest difficulty will be in getting the thing "stirred up:" If it can be "stirred up" and brought to the attention of the national congress on the floors of the house of representatives, it is my individual opinion and I think the belief of the rest of the committee, that the copper tariff will not last long.

I ought to say I am but one member of the committee present. Mr. Brown, the chairman, is unable to attend, and Mr. Morrison, we all know, is unfortunately prevented from being here. I have made out this report after conference with Mr. Brown, but have not been able to see Mr. Morrison.

I ought to say further, perhaps, as a matter of record that there was no appropriation made for the work of this committee. Your committee have expended a considerable sum of money, and a great deal for printing and postage was required. In due time when we are through with our work, we may present, for the information of the association, a record of this matter.

PRESIDENT WEEKS: Gentlemen, this subject is a matter of great moment. Aside from its national, I might say international interest, it is a matter that comes right home to every one engaged in the electrical business; and it illustrates very nicely the community of interests that prevails, and we should all appreciate and understand it. Whatever affects the manufacturer of electrical apparatus, affects the user of that apparatus, and what affects the user of that apparatus must necessarily come right down to the user of the product of that apparatus—the general public.

A motion that the report be received and the committee be continued, was adopted.

Secretary Garratt stated that the report of the committee on underground conduits and conductors was in the form of a letter. The chairman, Eugene T. Lynch, Jr., stated that the committee had been unable to hold sessions. He suggested that "the convention appoint a committee with the idea of bringing in some of the 'New Blood' of the association into this active and interesting field. The experience to be gathered from the operation of such wires that have been buried in New York City (most of which have proved failures up to the present time) can be easily gathered in time to report to the next meeting of the convention."

The report was received, and the committee discharged.

PRES. WEEKS: We will now receive from Mr. Smith, the report of the committee on standardization of potentials, on street railways.

REPORT OF COMMITTEE ON STANDARDIZING OF POTENTIALS.

In behalf of the committee appointed at your last meeting for the standardizing of potentials for electrical apparatus for street railway systems, I would present to the association the following report:

It was deemed advisable by the members of the committee to send out a circular to all railway companies operating their systems of car lines by electricity notifying them of the appointment of this committee, and asking not only their co-operation, but also drawing their attention to a number of questions that we desired they should reply to. Acting upon this conclusion the committee drew up and mailed to all these companies the following circular:

Gentlemen:—At the semi-annual meeting of the National Electric Light association, held at Niagara Falls on August 6th, the following resolution was offered and adopted:

"WHEREAS, It is the belief of the members of this association that the electric motor service upon street railways will require a service of electric current for the motor that will be reliable and constant, and that the various electric light stations are capable of generating and distributing such current.

"*Resolved*, That a committee of three be appointed by the president, who shall endeavor to make such arrangements with the manufacturing companies that they shall adopt some standard potential to be used upon the various railways. The committee also to collect such data regarding the supply of current to railways as may be deemed of interest to the association."

The president appointed Messrs. Eugene T. Lynch, Jr., of New York, T. Carpenter Smith of Philadelphia, and Marsden J. Perry of Providence, as members of that committee.

It has been thought advisable to collect and compile the opinions and the experiences of such street railways as have adopted electricity as a motor power. Will you, therefore, kindly fill out and answer such of the following questions as you feel you can answer:

1. What system do you use?
2. What proportion of your cars are equipped with motors?
3. Do you generate your own electrical power, or are you supplied by an electric light station?
4. What proportion does your greatest average horse power in use bear to the total horse power of engines and boilers which you have installed?
5. What is the voltage or pressure of your generators?
6. Is there any other railroad in your town using an electric system? If so, what system do they use, and do you know the pressure at which they run?

We have received replies from 85 per cent. of all the electric street railway companies. They have one and all showed every disposition to give us full reports upon the questions that we have asked them, and have stated that they would afford us every facility that lay in their power, and that they desired us to convey to the National Electric Light association their hearty indorsement of this plan.

We think it advisable to divide our report into three parts: First, a statement of the conditions under which the various railways have been operating up to the present time; second, the report of your committee upon the arrangements made with the manufacturing companies; third, all of statistics carefully compiled from reports made by some of the most prominent central stations showing the advantages that will accrue to the investor by the combined operation of the electric light and electric street railway interests working under the agreements that have been promised to your committee.

First. Under the first question we do not desire to give any statements regarding the number of railways that may be operated by any particular company beyond the fact that fully 90 per cent. of all the railways now in successful operation are operated under the systems controlled by the Thomson-Houston and Sprague companies.

In answer to our second question we find that at least three-fourths of the railways have equipped all their cars with motors, and that the sizes of the motors upon the cars vary from 7½ to 15-horse power.

Third. Only nine electric light companies have been brave enough to agree to supply the street railway companies with their power, although in nearly every case when the railway was in operation there was at least one central station company who could have contracted to supply the necessary current.

The answers to the fourth question give to your committee the information that will prove of value to the association. In all railways operating over fifteen cars only one-third of the total horse power with which the plant has been equipped, has ever been called for at one time. On all roads operating between five and fifteen cars the greatest average load has not reached 50 per cent. of the total horse power, and upon smaller roads the average load has varied from 50 to 80 per cent. of the total horse power. All roads that have met with heavy grades have raised the average very considerably.

We find that the potential varies from 220 to 800 volts. The greater number of companies, however, report using a potential between 450 and 550 volts.

Our sixth question was directed partly as a check upon our being furnished correct information upon the names and locality of the various roads, but mainly to ascertain whether an opportunity was afforded to operate several street railway companies from the same central station plant.

The answers to this have been many and curious. In some cases they have disowned all knowledge of the existence of any other company, and in nearly every case they seem to be imbued with the rivalry quarrels or misunderstandings of the various patent or manufacturing companies whose apparatus they are using. They agree, however, that they would be willing to use the power supplied to them from some central station, provided that they be assured by the company who equipped their road that the potential of quantity of current used would not be detrimental to their apparatus.

Copies of the circulars, together with a letter explaining more fully the plan suggested by your committee were sent to all the manufacturing companies. They were also requested to furnish the committee with a list of the particular railways operating under their systems. After much correspondence and many personal interviews, your committee would announce that they have written authority from both the Thomson-Houston and Sprague Street Railway companies that they will agree hereafter to use a standard potential of 500 volts upon all electric street railway equipments that do not require any special apparatus for their successful operation.

In recommending electric light companies to add to their regular central station business the business of furnishing power to street railroads, we wish it fully understood that we do not base any hopes of profits to be made upon the old-time idea that the same machinery can be used for furnishing light at night and power in the daytime. This specious argument has led many companies into large expenditures for motors, etc., and they have discovered later that it costs very nearly twice as much money to run the same machinery night and day as to run it at night alone, and that it pays better in the long run to have an entirely different class of apparatus to produce light and power.

The true direction from which returns may be expected in the massing in large stations of the generation of electricity for both light and power, is found in the fact that an electric light station to be sure of a continuous running, requires a reserve of from 15 to 25 per cent. of its average load in boilers, engines and dynamos; the per cent. being larger in small stations and diminishing as the station increases in size.

This same reserve in capacity is required for the power station, but on street-car work in most of the stations hitherto installed, this percentage runs very much higher, being from 50 to 80 per cent. It will be manifest to every one on a little reflection, that a station which is generating current for two street cars, is compelled to have power enough provided to

allow of the throwing on at the same instant of both these cars, that is to say, generating capacity of fully twice the average amount of power, or 100 per cent. reserve; as more cars are added, the chance of any particular number being thrown on at one time becomes less and less, until in a station operating two hundred cars, a single spare generator to take the place of any one which might be disabled, would probably be all the reserve needed. This feature is shown very clearly in the running of the ordinary three-wire electric station, where when the total load is light a few lights thrown off or on either side will make a big difference in the balance, but as the total load increases, the number of lamps thrown off or on either side at any one instant is so small a percentage of the total load that the station needs practically no balancing. Now if any one station supplying electricity for all purposes in a town, we have say 25 per cent. reserve in boilers, and 25 per cent. reserve in steam engines in excess of the average load, we shall only require to place 25 per cent. reserve, each, on electric light dynamos and power generators to have practically the same result, as though we had two complete and separate stations for electric light, and for electric power, each with its proper reserve of 25 per cent. extra in engines and boilers and dynamos.

Another important point to be considered, and one well worthy of consideration by electric light stations, is, that in many cases they could furnish this current delivered at the walls of their stations; that is, the car company will take care of its overhead lines and connections, and the electric light companies be paid a rental simply for the electricity delivered to the car companies' lines.

As an instance of what may be done in increasing the output of a station, without corresponding increase in expenses, we quote the case of a small station, which, as nearly as can be determined from results, shows the following condition of affairs:

The station increased its business in 1889 over 1888, 23 per cent., and in the same time the total expenses including the extra line work and distribution expenses 10 per cent., which 10 per cent. meant 10 per cent. increase in running expenses, and 10 per cent. in fixed expenses. The company contemplates a further increase of 27 per cent. on the same basis; this increase, however, being for power furnished alone, without any line work involved; the most careful calculation shows that this will only increase the present running expenses 10 per cent., without increasing the fixed charges at all.

In 1888 the proportion of fixed charges to running expenses were 25 per cent., and 75 per cent. respectively of the total expenses. In 1889 this same proportion held good, each having been increased 10 per cent., as above stated, and the total expenses having increased the same amount. The further expected increase being 10 per cent. of 75 per cent. will mean an increase in the total expenses in 1890 over 1888 of 17½ per cent., while in the same time the total output of the station, and consequent gross receipts, will have increased 50 per cent.

These figures are all taken from the case of a small station, with a total output of some 350-horse power and a fresh increase in this station (above this point) will result in an entirely different condition of affairs, so that a readjustment will take place in the proportion of fixed expenses and running expenses. We therefore present the report of another station which is operating 1200-horse power, in which the total operating expenses are divided into 80 per cent. running and 20 per cent. fixed. On increasing the station to an output of 1800-horse power the increase to be entirely in the furnishing of power, the increase on total operating expenses would be about 14 per cent., and the ratios of fixed and running expenses would be as 15 per cent. and 85 per cent.

The report of another large central station operating at least 2500-horse power has been divided somewhat differently. The fixed charges are 14 per cent. of the total expenditures. All labor and pay-rolls amount to 41 per cent. and all material, such as coal, carbons, lamps, wire, oil, etc., amount to 45 per cent.

Taking in account all their past calculations and experiences, they are very confident that they can operate at least double their present output, be it light or power at one-fifth more for fixed charges, one-third more for all labor and pay-rolls and say three-fourths more to their present material item, making a total additional charge of say 50 per cent. upon their present expenditures and giving them in return at least double the gross income. As stated before it will not be found advisable to calculate upon using the same engine, boiler, and dynamo power for the double service for lighting at night and power during the daytime, except of course in some few isolated cases.

The great saving for the central station company lies in the reducing in labor and fixed charges and also that the reserve power for one will suffice for the other. Your committee feel that a great step has been taken in the right direction in securing the indorsement and co-operation of the largest and leading companies, and they would suggest to the association that some measures be taken to secure from the stationary motor companies the adoption of some standard potentials for their use upon constant potential circuits.

PRES. WEEKS: We will have a general discussion of this topic at the same time that we have a discussion on Mr. Sprague's paper on electricity as applied to street railways. We will hear from P. H. Alexander of New York, the report of the committee on harmonizing insurance and electrical interests.

Mr. Alexander then read the report of the committee as follows:

REPORT OF THE COMMITTEE ON HARMONIZING INSURANCE AND ELECTRIC LIGHTING INTERESTS.

The committee on harmonizing the insurance and electric lighting interests was continued at your session, held at Niagara Falls last August, and requested to confer once more with the fire underwriters regarding the best means of preventing fires from electricity, and to try and bring about a reduction of insurance on the buildings lighted by electricity. The committee has had many sessions, and a great deal of correspondence with fire underwriters, and can only reiterate the recommendation made at the last meeting of this convention regarding the desirability of examining and licensing men employed in electric lighting and would further recommend all electric light companies to contribute toward the remuneration of several expert electrical engineers in different parts of the United States, who should instruct special agents or inspectors of insurance companies in the necessary knowledge to discern between good and bad electrical installation. The committee thinks that special agents and inspectors of insurance companies ought to qualify themselves in inspecting electrical installation, as far as fire is concerned, the same as they qualify themselves in inspecting other appliances put up in buildings, and judge of their relation to fire hazards. The committee realizes that as long as inspectors are employed at the expense of the electric light companies, underwriters will take no pains to acquire for themselves the necessary knowledge to inspect such risks. The committee would therefore recommend to electric lighting companies the appointment of an instructor to special agents for a period not exceeding one year, feeling certain within that time every special agent and inspector of fire risks could acquire all the necessary knowledge to enable him to judge of electrical installation as far as it applies to fire hazards. The committee has communicated this, its ideas, to underwriters' associations and insurance boards, but must confess that it has not met with the favorable responses to this proposition that it anticipated; however, the insurance interests seem to be willing to take some steps to bring about the harmonious relations so much desired. Your committee was also instructed to report upon the advisability and feasibility of a mutual insurance company for insuring central stations. A plan was proposed by S. E. Barton, and Captain William Brophy, both of them well known to you, for the establishment of such a mutual insurance company, a prospectus of which is filed herewith, and has been forwarded to the members of this association. The committee after carefully considering the plan of operation as prepared by these gentlemen, has unanimously indorsed their ideas, as have a great many central station men of note, members of this association, as well as of the association of Edison Illuminating companies. The plan proposed, will not only reduce the cost of insurance, but will aid in perfecting the construction of central stations; and by frequent inspections will aid the managers of such stations in the knowledge of modern appliances. Your committee would be glad to have this matter freely discussed here to-day to see if the project is not worthy of the official indorsement of the National Electric Light association.

DISCUSSION.

GEORGE CUTTER of Chicago: We have looked east for information as to harmonizing electric light and insurance interests. We feel to-day that this is necessary, and that we will derive a great deal of good, both the insurance interests and the electric light interests, from action of this kind. A thing of great importance to us in the west is to have this movement pushed rapidly forward, so that our electrical engineers will know what is best for the best class of work. We find constantly people who want their work done according to insurance rules. We have no insurance rules. I should say we have a variety, but one engineer works upon one line of insurance rules, and another engineer follows another line. For instance, a short time ago, a movement was started in Lake View to secure the putting of wires underground. As a sort of compromise, it was published in the papers that a compromise was made by which the wires were to go under the street, and then over the housetops. In some insurance rules special mention is made that the wires should be kept away from the buildings; and this appears to us as all-important. I feel that if a committee composed of electric light men and insurance men would work together to outline a national line of rules to influence the electric installations all over the country, we would all be benefited by it. The necessities of the case have given rise to the growth of another line throughout the west—that of consulting engineers. The uncertainty among purchasers of electric light plants, from the many contradictory statements made by salesmen, has made a demand for consulting engineers in the west, and this demand is being filled in a very unsatisfactory manner. These engineers are opening offices in different places, and traveling about as consulting engineers, and among them are many who have no practical experience whatever in putting in installations. They drift around and talk with one party and another, and in that way we get a little information. I feel that in connection with this committee, in the same line of thought which is advanced in the report, a superintendent of installation should pass an examination. This would sift out these so called electrical engineers, whose knowledge extends, perhaps, to the putting up of a vibrating bell somewhere, and who know absolutely nothing about electric light plants. The inspection of an electric light plant requires experience in installation and in handling the apparatus, and that would be one point to be taken into consideration by a joint committee working in harmony. Now, the thought that I wanted to express is as to the value of a standing committee composed of electric light and insurance people working in harmony, to keep pace with the growth of our industry, so that we may know the best method of installing the apparatus. New ideas are being advanced constantly, and there is a diversity of opinion as to the correct use and installation of apparatus. This committee should be ready at all times to act, and should very carefully study the question, so that they may outline the proper rules. It seems to me the question divides itself practically into two parts; one, the insurance of the central station, in which the situation becomes simply that of buyer and seller; and second, insurance outside of the central station. There our interests are identical. The electric light companies want that work well done, so that they will have no unnecessary expense, and so that the public will feel that they will have no accidents. The insurance people also want the same thing. Their interests are identical, and it is in this line particularly that a committee, consisting of members of both branches working in harmony, would accomplish a great good. Therefore the consideration of the question could be left to a committee appointed by the National Electric Light association and representatives of the insurance companies. In all probability that committee would consist of members in different sections of the country, so that the tendency of sentiment in each section would be represented in that committee. Such a committee would soon get a thorough knowledge of the various rules for installation throughout the country among the electric light people, the underwriters and the architects, and this, together with the knowledge of the members of the committee, would bring about the adoption of a set of uniform rules which would control our installations all over the country. In this way the people of the small towns in the country would have the advantage of knowing what the insurance rules were, and would have the means of knowing what proper installation is. The result would be that the public would finally gain that confidence in electric lighting which it deserves, and the purchaser of an electric light apparatus would have information as to what good installation is. Therefore, this committee which we appoint now, should work in connection with the insurance people, looking to the establishment either of a standing committee or some board which would be a body to which should be referred important questions for final reference in relation to installation. I think such a body as that would ultimately become a great power in the land, and with careful work would make our business known to the people and do away with the scare which exists to-day, and would also check the growing tendency among politicians to interfere with our work. They are finding that it is profitable, and the more they find that out the more will they interfere with us and our rules unless we have a power derived from an influence obtained through public opinion, which will check this interference by politicians that will be disastrous to our industry unless it is checked.

T. CARPENTER SMITH of Philadelphia: I am very much in favor of such a committee as has been recommended. I represent a company in what is usually called a pretty slow-going town, but notwithstanding that, we have made progress there. In Philadelphia we have an insurance inspector, who has taken a very original course. He absolutely refuses to lay down any rules for wiring, on the ground that just as soon as an absolute rule is made, just so soon will be found the means to evade it. He has also been opposed very much to the licensing of wiremen on the ground that while you may very easily control by a license system the extent of a man's knowledge, you cannot control his trustworthiness. We have men who are doing wiring as contractors in Philadelphia, who can pass any examination which can be made. Yet these men will deliberately splice underwriters' wire on the inside of a building, and splice waterproof wire on the end of it where it comes out, and they will even wrap tin-foil around it, so that it looks as if it were soldered. Now, no licensing system will control men like that. These are the points which I think the committee should take very carefully into consideration when they try to draw up any set of rules. After all, it comes down a great deal more to common sense than electrical knowledge in doing wiring, especially about central stations. At one time in the early history of the art underwriters' wire was cleated to the floor and run through a house without any rubber around it, and it was thought that was good enough. Then we got a great scare about the water-proof business, and everybody lumbered up space with rubber-covered wire and other things. Then we got to running rubber-covered wire on glass insulators, and thought that was just the thing; but a day came when we found that the rubber cover carried the flame better than the electricity did. Now we have got down to porcelain and glass insulators. We have begun to find that our old despised friend, the underwriters, is not a bad thing to go through a building, because while it may get wet, it will not carry the flame. I think 90 per cent. of the little troubles occurring in Philadelphia come from the flexible cord which has been handled until all the strands are broken. All at once a little blaze is discovered in the ceiling. The people, then, instead of knocking it down and throwing a bucket of water on it run out of the room, and before anything is done to check it, it has got a great deal of headway, and makes trouble. Now, in Philadelphia, a scheme has been formulated which has the germs of a very good system in it. The electric light companies cannot compel a customer to have his building wired properly. If they attempt to do anything of that kind, the customer says: "I will get some other company to do this," and after the work has been once done in his building, no matter how dangerous it is, you cannot get him to change it. There are so many advantages in coming under the law of common carriers, that I think it will be found on examination to outweigh the disadvantages, if we can only get some way of compelling customers to put the wiring in their buildings in a safe condition.

There is no question but that the insurance people can compel a customer to do anything. The worst class of customer we have to deal with is the very one who is scared the most about having insurance taken off his building, and a mere suggestion or hint from his insurance company that it will not continue his policy, will bring him to terms in a moment. I think, therefore, that we should attempt to throw the onus of all compulsory work on the insurance companies. It does not affect their business a particle. They can put a man's premium up 2 per cent., and it makes no difference. They can get his insurance

just the same, because they are a strong body, and when they have agreed to do a certain thing, they do it, and no man can afford not to have his place insured.

We are talking of an arrangement which I think will go through, whereby the electric light companies are to pay an annual sum to the insurance companies for every arc light installed, and for every incandescent light installed. This is to apply to the maintenance of a staff of skilled inspectors, who shall not merely inspect all new work, but shall periodically inspect all work already installed, so that any changes may be examined and any man who is found sticking 50-candle lamps on a wire that was meant for ten, can be detected. This practice will be stopped by a power that is greater than the power of the electric light men, the threat of withdrawing insurance. The matter really comes down to this: That a certain sum has to be paid every year for skilled supervision and inspection of all new work and all work already installed, the costs of this inspection to be divided pro rata among every user of incandescent and arc lamps, the only difference being in the case of people who are supplied from central stations, that the central station shall bear that expense. Now, as a central station man, I think that the cost of such a system would be ten times paid to an electric lighting company every year, in the satisfaction they would have of knowing that somebody else was responsible for the condition of their numerous wires. We must remember that the electric lighting business is a lighting business; and if you make money in it, you do so, not because the lighting is done by electricity, as a great many people seem to think, but you make money in it if at all, because electric lighting is a very good business. Now the gas companies have got to a certain condition after forty or fifty years of hard experience. They did not get their experience from having somebody sit down and figure it out for them. They started, just as we have, by piping people's buildings and doing everything of that kind. Gradually they began to cut off these little luxuries, and now they have got down to delivering gas at the customer's premises. They put their meter in and are responsible for it, and beyond that they are not responsible; and the electric lighting company must get there too just as quickly as possible.

M. J. Francisco, Rutland, Vt.: In regard to this matter that Mr. Smith has referred to, he has overlooked the fact that in New England we have an association of the very kind that he desires in Philadelphia. It is the New England exchange; that is, the electric light exchange, and we have also the New England Insurance exchange. The two are working together as one body, practically; that is, the orders of one go into the other and they are enforced by one organization. Now, then, in regard to this wiring business. If they have the proper men in Philadelphia to examine the wiring, I do not think they will put much tin-foil in place of solder. At least if they ever try that with Captain Brophy as inspector, they will get terribly left. He is the inspector for New England. But there, we have this plan: These men are licensed. One of the conditions that has to be considered is the moral character of the man. That man must have a record; he must have a standing, or else he cannot procure a license to do this business. And here is another thing which is a very important item in regard to wiring houses and buildings: All such buildings have got to be wired, in accordance with the rules of the Insurance exchange. After they are wired, the electric lighting company invites the exchange to send its inspector there to make an inspection of these wires. If they are in accordance with the rules of the exchange, as well as of the company, they are passed; if they are not, they must be taken out and be put in as they should be. The moment they refuse to do that, not only do they receive the electric lighting company's order to discontinue the current, but they have the Insurance exchange to deal with, which cancels every policy on that property. That is the basis on which all this business should be carried out through the whole United States. These organizations of exchanges and insurance companies should be effected throughout the entire United States. That was the plan discussed at Niagara Falls, and that is one of the objects of this committee in making this arrangement. I have been engaged in the insurance business for about twenty-five years, and I have had a good deal of difficulty in getting the companies to believe that electric lighting plants were good risks. In the discussion of this exchange business, this matter of these mutual companies has been brought up. We will of course run on a stock basis. I have always been a little skeptical, but in this present insurance association, the one that has been inaugurated here at this association and practically indorsed, we have at the head two men who have had as long and as varied experience probably as any men in the United States. When you put those men, with their experience and knowledge, at the head of an association of this kind, to effect and carry out these plans, I consider that we have got a plan that we can all heartily indorse, and one which will give us insurance at its actual cost, and give us insurance in a shape whereby we can cover property, and not have, as a large number of stations are now, our property without any protection whatever. In the last year I have received 150, if not 200 letters, in reference to this insurance matter, asking: "Why cannot we get our property insured, and how can we arrange these stations so we can insure them? Can it be so arranged?" Well, of course it can be so arranged, but under present arrangements there is no inspection. The new companies are going to put in a station, but they do not understand the rules of the insurance companies, and they do not understand how to arrange these stations. They may proceed in such way as to destroy their insurance at once. Now, if there is a proper inspector, he goes there and sees these plans and points out the defects, and says: "Now, you fix that matter there in proper shape, and you are all right; you can get your insurance without difficulty; it will come all right." And that is just the plan, as I understand it, of this mutual combination. I have had letters, numbers of them, from parties who said: "The insurance companies are charging us 5 per cent. on our station." Well, of course there is some reason for that, as companies do not do such a thing unless there is some reason; but in many instances, it is because the companies do not understand the rules and principles to apply in arranging the stations to properly protect insurance companies. And, of course, the insurance companies in a large number of cases have inspectors of insurance risks, who know little or nothing about the electrical part of it. Now, in this case, as I understand it, this inspector is to be a man who thoroughly understands the electrical part, and can explain all of those dangers that every station has to meet, in running its current, and in arranging its station. And I am heartily in accord with the idea, and I trust every station man will investigate the matter and look the thing up, and take hold of this subject in the proper spirit and carry out finally, not only the insurance part of it, but also this matter of organizing societies or exchanges, for the purpose of combining the interests of the electric lighting people and the insurance people in regard to wiring.

Dr. Mason, of Boston: Do we understand, Mr. Francisco, that you object to the idea suggested, that there should be a national insurance exchange, as there is a New England Insurance exchange, and as there are other exchanges?

Mr. Francisco: The idea of that is simply this: A national exchange would be too extended to be practical. As suggested by the committee, we have now the New England exchange, then we will take in the Middle States, then the Western States, the Southern States so as to make a department each by itself, the same as the insurance companies do at the present time. Now under this arrangement of this matter, we can carry it forward on precisely the same plan. Divide them up, but have them all under one head in the National association.

Mr. De Camp: The same as the National Board of Underwriters?

Mr. Francisco: Just the same; this National association takes the place of the National Board of Underwriters.

J. E. Lockwood of Detroit: I would like to suggest in support of the idea that has already been advanced, of the harmonizing of the electric light and the insurance interests, a step that has also been taken, in the direction of forming state electric light associations. This, it seems to me, is the proper time for the electric light association to make use of the state association for the purpose of getting direct communication with each local organization in the country. The importance of this question depends, I think, in each state, upon the question of the organization of the electric lighting interest in each state and city. As there are electric light interests in each city, so also are there companies in each city and the National association is represented in the local organization. I think if this committee is formed, its function could be more properly performed by creating and formulating the ideas derived from men of experience all over the United States, and which information could be gathered and furnished by the state association. Then let each state association apply in its own state this information and instruct all of the electric lightning companies and the insurance men throughout the state, with the proper rules for wiring; and then through its own members, residents of every city of the state where there are electric light plants, see that these rules are carried out. In Detroit we have had the same thing to look out for. We have just formed a state association. There are probably at present, not less than a half dozen different companies doing wiring of buildings, in one of which that I know of, the wires are being concealed within the mortar; and for a single light they are putting in No. 20 wire which I know is smaller than is thought proper. We have fortunately not had a great many fires; but we have had our attention called to these facts and the number of accidents in other cities which have been published in the papers. Our state association intends making its best effort to thoroughly investigate this matter of wiring and to formulate rules and endeavor to practically carry out these rules. We shall look over the work of the state and see that no work is done in future that will not be strictly good electrical work. I trust that when this committee is formed that it will carry out this work in such a manner as to make the state associations the mediums of communication between the National Electric Light association and the people whom we are going to reach.

T. Carpenter Smith: I do not want Mr. Francisco to suppose for one instant that we allow such a state of things as I spoke of to exist when we know of it. The point I wanted to make was that the moral character of the wire man was only good when you know it. We have had a good many bank presidents and cashiers who were very worthy, responsible and trusty men—until they went to Canada. And it is the same way with the wire man: He is all right until you catch him. And in order to catch a man's moral character you have got to have some way to defend yourself from that man after you have found him out. Now, as I say, our record in Philadelphia on the question of fires shows we have a good system of inspection there; that is, that the work has been well done. But where a wire man is at work on the sixth or seventh floor of a building and he has got one more joint to solder, it is an awful temptation to that man to twist a little copper wire and let that slide in a place where it will never be opened. You take a building with 3,000 lights in it, and there are a good many of such, where every foot of wire is concealed, you would have to put half a dozen inspectors on that one building, the whole time the work was being done to know that every joint was soldered. I am strongly in favor of a committee of this kind; but the point I want to make is, that we must look more to getting honest work, than to laying down rules that can be evaded. You must make it a question of principle. I would like to see some system devised which would be practicable, and leave the question of rules as much in the background as possible.

With regard to electric lighting stations, there, there is no necessity for concealing work of any kind. The rules that govern ordinary fire risks, I think apply more to central stations than to any other buildings. I think there is infinitely more danger in the electric lighting stations from the boilers, engines and heating apparatus, than from the electric lighting wires, except, of course, the habit of throwing water on machinery that gets heated up, and I guess none of us would think of that, although we have heard of such things being done.

Mr. Cutter of Chicago: About four years ago, I think, the New England exchange was started. I like the idea of it. But must we wait four or five years for an exchange in the West, and then another lapse of time for one still further west, and then finally join them in the National exchange? Can we not start the ball rolling to-day and from the National Electric Light association have a national exchange that will establish the necessary organization? We do not want to wait longer in the West for the good results that you are getting in the East. We want if possible to start some sort of bureau or exchange, or association, whatever you may call it, that will be a national affair, that will be the center of information for the best class of work and the best policy to be pursued in putting in our plants. And we want, if possible, to start from this association and at this meeting. Now, the New England exchange has a sound policy, and it certainly seems to me that the ideas expressed by Mr. Francisco are excellent. We want this to be on a national and broad basis. I feel that if the wire men of experience and the men who are working on important parts of construction are required to have a certificate from certain associations, and that when any wire man carrying such a certificate is placed on work, and is caught leaving an unsoldered joint, or covering a joint with tinfoil, that he must lose his certificate, that is something more than a moral power. It is bread and butter for the next week or six months, and he will not want to lose that certificate. We want this committee to be appointed on a basis, if possible, for prompt action, to organize the National Electric Light exchange, if you want to call it so.

Mr. De Camp: It has occurred to me that the committee is doing a great deal of unnecessary work. That is, it is work that will come before them in the future. As Mr. Cutter just remarked very pertinently, we do not want to wait four or five years to educate up a corps of competent construction men. There is one point in this that ought to be considered: The old axiom, no rule is without its exception, is particularly true in this case. What is necessary to be done in one class of work is not so necessary to be done in another. Therefore I think that the true way for getting at this, in the first place, is for this very admirable committee to devote its attention to the education of a corps of first-class inspectors and let them be taken from among the construction men. Now that works in this way: As long as you are engaged in any business which has the cupidity of the general public to deal with, you are going to be utterly unable to control it by any set of rules and regulations which you may lay down. In the case of the arc light company in Philadelphia at least, and I think it is so generally, the cupidity of the user of the light is not appealed to from the fact that the company itself does the wiring; but in the case of the incandescent company it cannot afford to do the wiring, and happily the rule has not been established. There the consumer pays for his own construction. The lighting company informs him that it is necessary for him to do a certain amount of work and that he will have to pay for it. For my part I would prefer that that should be done by outside parties. I do not consider it strictly in the line of the business in which we are engaged. He immediately sets out to find whom to get to do that work; he will give it to the lowest bidder ninety-nine times in a hundred. Now the man who makes the most plausible statement and makes the lowest bid will almost always get the contract. The party who is letting the work has no means of knowing whether it is a proper piece of work or not. He is not educated up to that, and you cannot educate him, but he will believe what he is told by the insurance fraternity. He has an interest in his insurance. If it is a question whether he will dispense with insurance or dispense with our light, he will dispense with the light every time; but if it is generally known that the insurance company with whom he is doing business has a competent inspector, then that contractor must do that work under

an educated and thoroughly competent inspector; it makes no difference in that case whether he employs a good workman or a bad workman until the inspector passes upon it. Another duty that I think is an important one is to educate the insurance companies themselves to know just how much there is in this business. I think it is Mr. Woodbury who is responsible for the assertion that where establishments were properly wired, the insurance companies expressed a preference for that kind of risk; that they considered it decreases their risk rather than increases it. Now, that is just exactly what we want. There should be no difference between the lighting companies and the insurance companies on that point, but there is a gross inconsistency about this matter between the lighting companies and the insurance companies. We have in Philadelphia, I think, three station risks that are first class as risks, barring out anything electrical, but still the insurance companies discriminate against those risks, and give us a higher rate. We ask why? "Well, it is an electric light plant;" that is the only answer we can get. We have to submit to that, because otherwise we cannot get insurance. We get our insurance down to one-half, and then it gradually begins to crawl back again. There can be no better proof than that that the insurance companies want our risks, although every once in awhile they go up in their rates, and I think that just as soon as we have a corps of inspectors in which the lighting companies and the public have confidence, you will get rid of a great deal of difficulty. It is one of the best ways of rooting out incompetent workmen. I suppose there are fifty, maybe a hundred, so-called construction companies in the city of Philadelphia to-day, and when we have occasion to discharge a workman, the chances are two to one that he will turn up in time as an electrical engineer; that is the class of men we have going around. Without a dollar of capital they will take a bid on a contract amounting to a thousand dollars, perhaps, without the ability to carry it out. They manage in some way to get their goods; they will say they have such a contract, and want $400 or $500 worth of goods and cannot pay for them until they finish the job, and when they get paid for it they will turn the money over. Now, if those men are watched and cannot get their work passed, and they cannot pay their bills, their creditors will find that out as soon as anybody, and in consequence there will be no bills to pay and they will gradually drop out of the field. That plan will result in raising up a good corps of competent men. We have in Philadelphia one inspector who has done all the good work that has been done there up to this time. He works by no set rules. He goes by common sense, and that he is pretty near right I do not think requires any better proof than the fact of the little trouble we have had up to this time.

M. J. Perry of Providence, R. I.: One very strong point has been brought out by Mr. Smith and that is, that the combined insurance interest, rich in its aggregate capital of hundreds of millions of dollars, this morning requires to have the hat passed around in this convention to the tune of two cents to each lamp; that is a fact I am very glad to learn, and I shall take that back to my people with a great deal of satisfaction. You appointed a committee a year ago, of which I had the honor to be a member. Its report has been before you for discussion. We labored during the year and brought forth our report, and I am quite proud of it. If we go on formulating exchanges and working down through school districts and up through counties and states and finally having this grand National Insurance exchange, we shall have a grand institution, but what will become of the wiring and the general progress of the business while we are waiting for that concern? If one year ago, when this committee was appointed, you had simply recommended to the insurance companies that they send their inspectors to first-class, reputable electrical engineers, and they had spent one week in connection with those gentlemen inspecting the installations in almost any town, at the end of that time or a fortnight they would have sufficient knowledge to enable them to decently inspect almost any ordinary installation, and the whole thing would have been settled. That is where it has got to come finally, and we might just as well begin at that point as to spend a year getting there. There does not exist any necessity whatever for this grand and intricate organization; not the slightest. Why should our business be made a special exemption from the ordinary routine by which such matters are accomplished? Why is it that we are compelled to pay 80 cents for an arc light while a gas company is called on to pay only 10 cents for a gas burner? There is not the slightest occasion for it. There is no mystery about the carrying capacity of a wire. For one cent you can buy a set of tables which any mechanical engineer will indorse as being perfectly safe to follow. It is a very simple matter, and it is a matter that rests entirely with the insurance company finally to say that they will or will not accept the installation. The question of poor workmanship will be settled by that very definitely. When a man or a construction company has made a bid so low that it is necessary to put in inferior work to protect against absolute loss, and the work has been rejected by the insurance inspector, and the man with whom he has contracted has thereby been given a just reason for refusing to pay the bill and he is obliged to reconstruct it and make it meet the demands of safety, there will be no trouble; he will not repeat the dose. I do not believe that there is the slightest necessity for going into this work at all. I think that this convention should carry out to a great extent what we have recommended in the reports, that the insurance inspector who steps into a building and is competent to inspect everything in it except electric wires, should make himself competent to inspect that risk and accept or reject it for cause.

Mr. Armstrong of Camden, N. J.: I do not believe that this convention ought to employ an instructor of insurance inspectors. If we are to go into the business of employing schoolmasters for the populace, the first thing we will have to do is to employ a schoolmaster to go to Ohio. I saw in a paper here in town that a member of the legislature of that state had introduced a bill requiring all the dangerous electric wires to be buried throughout the whole state, and yet confessed in introducing the bill that he had never seen an electric light wire or an electric light until four weeks ago when he went to Columbus to be sworn in as a member of the legislature. I am sorry to have to admit it, for the sake of the argument, and I trust it may not be held against me, but I have been a member of a state legislature and I know something of the wisdom and intelligence of state legislatures, and if it is proposed by the aggregation of the electric light companies of the United States to endeavor to instruct men in what they ought to know, and in what they pretend that they are competent to do, we might as well surrender to them at once our whole plant and go out of the business. The insurance companies are to insure us, and as Mr. Smith well said, "I think they will very readily and speedily find means to ascertain whether or not the work that is done is properly done." I happened to be the president of a company that had constructed a hotel within about thirty miles of Philadelphia. We gave the contract to the lowest bidder, and so we ought to do. We would have been unfaithful to our stockholders if, when a man came, a reputable business man, and offered to do certain work for the least price, we did not give it to him. The insurance companies sent their inspector to see the work, and the work was condemned. We have not paid for it. We immediately notified him that we would not accept his work and gave the contract to some one else; the insurance companies did that; we did not pay for it; we do not propose paying for it. We do not propose paying for this inspection; they are the ones to do the inspection and tell us whether the work is done satisfactorily or not. We do not know anything about it, and we do not want to know anything about it. I am president of an electric light company. I do not propose to have my company either inspect or pay for the inspection of buildings; we will furnish them the light; they are to ascertain for themselves or for the people who underwrite them whether or not the work has been done properly. Now, certainly I cannot agree with that part of the report which recommends the employment of instructors for a year, for a month, for a week or for a day for the general or the special agents of insurance companies. Let the insurance companies look to that.

Now, as to the recommendation of mutual insurance companies for electric lighting, I should be very sorry to see this convention representing that it does advocate the establishment of any company to manufacture wires or any company to manufacture dynamos or any company to manufacture lamps or switches or anything of that sort, because, as an electric light company officer, I want to get the best at the cheapest possible cost to my company, and I do not propose to start something myself or in connection with other electric light men to beat down those prices. I have one branch of business, and while mutual insurance companies are a great benefit sometimes and in some places I want to indorse them to that extent most heartily, yet I feel that this convention would be making almost a fatal mistake if it adopted this report as it stands, recommending the institution of this mutual insurance company. Let us see ourselves that our work so far as our plant is concerned, is done with regard to our own safety. Let us see that it is properly done, and then we may rest assured as one gentleman on the committee, Mr. Perry, I think, said, that this great aggregation of millions of capital in the insurance companies will furnish to us insurance and underwrite us much cheaper than we can do it ourselves, so do not let us adopt that part of the report. I want to adopt every one of the remarks of the gentleman. One gentleman said that they had in the New England Electrical exchange so bright inspectors that they will never pass tin foil joints for solder. I did not suppose the pirates in the electrical wiring business would ever attempt to impose upon the people who know how to construct bass-wood bams and wooden nutmegs, but down our way near Philadelphia, where we have been honest for more than two hundred years, so that we have grown used to it, we have not had an accident by reason of defective wiring. It seems to me that the plan adopted there where the companies pay to induce the insurance companies to do the inspection, is the most profitable one. I am not in favor nor will our company pay anything to the insurance inspector. The insurance inspectors do well. We will have nothing at all to do with the wiring; we do not want to have any responsibility for it, and will not, and for one I am not willing to indorse the organization of any electrical mutual insurance company.

Mr. Perry of Providence: My remark relating to insurance companies applies specifically to wiring done outside of our stations, but I do unreservedly want to put myself on record as indorsing the plan for a mutual insurance company for central stations.

Mr. Alexander: New Jersey, as you all know, is different from any other state in the country, and therefore the insurance men there may be entirely different from the insurance men in other states; but we in New England have had the experience that insurance men refuse to insure us. Now, what are you going to do about it? Are you going to go without insurance because you think they are wronging you? No, you would not do that. They do not know anything about electric light. I do not blame them. They think it is a dangerous element. They say: "We are writing an understood risk, and we ought not to be put to the expense of providing a competent authority to ascertain how to estimate this new risk." They talk very fairly about it, much more fairly than you would believe. When they found the risk was a good one, they reduced the rate and to-day every building in Trenton that is lighted by electricity has a reduction of ten cents on its insurance rates. I believe the money paid by the lighting companies is flowing back into their pockets; their business has increased rapidly on account of the good inspection. That inspection cannot be done away with anywhere, because you will stumble over the same stone that we did. The companies will say they won't insure the building; that they didn't know anything about it. Now, we want their insurance inspectors informed on this subject, and that can be done within six months or a year, and therefore the committee thought it would be better for the electric light companies to expend a small amount of money all over the country within the next year to provide the knowledge necessary for proper electric light inspection, and then reap the benefit that we are reaping now in New England.

S. E. Barton of Boston: I am very glad that this association has at last dropped the question of underground or overhead wires, or of quibbling where we should hold our next convention, and has come down to the business of considering the subject before this committee, of which I have the honor of being a member—the question of harmonizing insurance and electrical interests. I was very much interested in the remark of the gentleman from New Jersey, but he evidently does not know what is going on in the United States. I have been an insurance inspector myself for fifteen years. I would not consider myself competent to be an inspector to day; I would not consider myself an insurance inspector in all that that term implies if I did not consider myself competent to inspect an electrical installation as well as a gas installation, and that is the very point that we are hammering at in the report of this committee. Now we have had the industry of electrical lighting going on in this country ten years or more, and to-day out of the nearly one thousand inspectors employed by insurance companies in this country I do not believe you will find two of them that pretend to know anything about the inspection of electrical apparatus. Why is it? Simply because they have let that alone as a subject too deep for them and left it to work out its own salvation, and in letting it work out its own salvation you have made the mistake. The installations all over the country abound with errors that are incident to first construction; things that could not be avoided, but things that can be avoided and remedied in the future. Good inspection you say is what you want; you don't want to pay for it, but you cannot get anything in this beloved country unless you pay for it, or give an equivalent in some way. Now we have examined this matter, and we have taken the position that the man to inspect the insurance business is the insurance inspector who inspects every other hazard. He is not competent to do it to-day. You yourselves who have been in the business all these years know that he cannot be competent to do it without more instruction. He cannot qualify himself in a day; he cannot qualify himself in a year without an instructor. He is busy day in and day out from one end of the year to the other in his regular line of business. Now we have taken the stand and hold to the proposition that it is wise for the electric lighting people, not this association, but the electric lighting people throughout the country, to put their hands into their pockets and say to the insurance fraternity: "We will provide the instructors, not to instruct the people of the country and the legislators, that would be a hopeless task, but to instruct the insurance inspectors in what is necessary to qualify them in their inspection." By the appointment of a sufficient number of instructors you could furnish object lessons to these insurance inspectors, show them what is necessary when they have to discriminate between good and bad work by showing the good and the bad to them, and have the understanding that we do this perhaps in a missionary spirit. This committee was appointed, not to point out what ought to be done, or what are the rights of the electrical people and what are the duties of the insurance people, but its very name says what it is for; it is to harmonize the interests of the insurance and the electric lighting people, and the way we believe they can be harmonized is by conceding on the part of the electric lighting people in the first place so many dollars and cents, to be paid out by the insurance people to the end that at a given time, giving them fair notice in the beginning, they are expected to have their men qualified and competent to do it, and take my word for it they will be so. Then you have your inspectors; you need not to create them; they are already created, and they have been given the necessary instructions to do just exactly what you want to be done. Now in Philadelphia, as Mr. Smith says, we are doing a grand work, but they are doing simply what we have been doing in New England for years, and you are reaping the benefits of it.

You are getting lower rates of insurance on properties lighted exclusively by electric lights than by any other class, and while the insurance side is losing nothing by it, we are making money. From my standpoint, as an insurance man, I wish every other kind of illumination was driven out, and that electric lighting was the only thing used. We would have a great many less fires. I believe the voice of this convention ought to be unanimously for it, and I believe I can safely speak for the insurance companies and say that they will heartily co-operate with anything in that direction. Now then I want to say a few words in relation to the project of an electrical mutual insurance company. I have had it in my mind for some time. If you will call to your minds one year ago at Chicago, in speaking upon electrical lighting stations as fire hazards, I said then that I believed the establishment ultimately of an electrical mutual insurance company, or something of that sort, would be the only solution to the question of insurance on central stations. I believe it more fully to-day. And I also said at that time that I believed that those few companies who are doing business in insuring electric lighting stations to-day, even in their deplorable condition, are making money. Now I know they are. Since this prospectus has gone out no less than eight of the large and prominent English and American stock companies have asked to have a hand in it. That is just what we want: something that shall prepare the stations to make them good risks, and conduct them so that they will give us a part of the insurance. That is the plan that is contemplated by the mutual company; it is not intended to antagonize the stock interest at all, but on the contrary to take in with it all those who want to come. Eight of them have manifested that desire, and a representation of the largest American company stated to me recently that it had been insuring electric light plants, central stations, for several years at nothing less than two per cent. They have made that the minimum rate and they have taken almost anything at two per cent., and have made money out of it. They have kept it to themselves; they now come forward and say they do not want to lose that class of business, but we want to come into this plan and take our share of it. A representative of one of the smallest companies in the country, a company which started a few years ago, told me that it took electric lighting stations simply because it wanted business and could not get anything else, and within two weeks he told me that its premiums in two years were over $60,000 and their losses less than $300 on electric lighting central stations. The companies want a hand in it; they have found that it was a good business, not because their wisdom taught them in the beginning, but because their necessities taught them. I think that you, Mr. President, advanced the idea to me that you thought your idea of harmonizing these interests did not coincide with the formation of an electric mutual insurance company, feeling that that would perhaps antagonize the stock companies' interests. That is not so, in the first place, and in the second place even if it were so, I would favor the mutual insurance company because it is undignified in the electric lighting association to throw to the stock companies their insurance business as a sop to keep them satisfied. It is not necessary.

I want to say a few words in relation to the examination and licensing of men employed in electric lighting installations, the work being done by the New England Electric exchange. I cannot agree with my friend Mr. Smith, that that method does not give a guaranty of the character of the man. On the other hand, that is one of the important features of it. It examines him technically first; it then considers his moral aspect and not a license is issued until it has been laid before and countersigned by the man who knows him personally and knows his habits and everything pertaining to him better than anybody else, and that is the inspector of the New England Insurance exchange. Every license has to go before him, and receive his countersign, and thereby the exchange has the guaranty that that man is all right in every respect. I know it is so, because I know that more than one man has not received a license simply because he did not meet the requirements in that one particular phase while he did meet them in other points. Now, Mr. Smith says we do not need rules for the installation of electric lighting apparatus. I can hardly agree with him there. I myself feel that the rules that we have in New England are on the wrong tack, that if those rules were turned around, and instead of saying what should be done in the line of safety, they said what should not be done, it would be more in accordance with my ideas. But we could not start that way. We did not know in the beginning what should not be done. We knew in a crude way what should be done; we have gone on, and from time to time, as experience has brought out things, we have added to those rules until they are complicated, and cover a great deal, not of ground, but of paper, and I believe, as Mr. Cutter said in the beginning, that it would be to the advantage of the electric lighting industry all over the country, if some sort of committee could be formed to draft a set of rules of some sort. It could be made a standing committee whose duty it should be to consider and revise the rules from time to time; then we would have some rules that would obtain not only in New England, but in California, and even in Chicago. When we first started the method of examination in New England, we had a different inspector for each locality, one at Boston, and one at Portland, Maine, New Haven, Springfield, Mass., and at Providence. What was the result? A party installing a plant in Maine was subjected to one set of rules; when he went to New Haven or Providence or anywhere else, he had to conform to a different set of rules, and that is the condition of things all over the country to-day. We ought to have some general rules, so that the party installing in New England would meet the same rules when he went to any other part of the country. I would like to see a committee appointed for that purpose, and I would like to have a good part of that committee made up of insurance men who are the only men who can enforce any rules you make. I would have a certain number of pratical electrical experts on the committee, and these men could be selected—one or two by this association, and one or two by your sister Edison association, and let the committee be large enough to cover the entire country and small enough so as not to be cumbersome, and let it govern the question of rules and let these rules be condensed and solidified and brought right down to what is useful for safety, and then have the rules so framed that the insurance inspector who can tell you all about everything except electricity, can understand them; then you have men spread all over the country to see that those rules are enforced, and before you know it you will not need any further inspection. You will have then a great governing committee who will stand behind this national committee on rules and amend them from time to time as need be, and the committee will be useful in many ways. Going back to the subject of mutual insurance, I want to impress upon you the importance of the fact that the inspectors of your mutual insurance company will be excellently qualified to give valuable ideas to the insurance companies. The company will break down all the barriers of prejudice; it will show to the country that you are not afraid to insure your own plants, that they are not those terribly hazardous fire generating establishments that they are commonly understood to be. I hope that the recommendations of the committee will prevail.

PRESIDENT WEEKS: We have with us Captain Brophy of Boston, of whom we have all heard much, and I am quite certain from whom we would like to hear more on this occasion.

WILLIAM BROPHY: I am pleased as one who has no pecuniary interest in any electric lighting company to have the privilege of saying a few words to this convention. I began, as you know, with the New England exchange four years ago to supervise and examine the work done by electrical people. I am happy to say that from the start I had the hearty co operation of every man engaged in that business. We have done, I think, a work that has been of exceeding great value to the electric light fraternity in New England. I think any one here who represents New England will bear me out in making that statement. The insurance people were entirely ignorant of this new element that was introduced into buildings that they insured, and naturally were wary of it; they felt that it was no part of their duty to maintain this inspection at their expense, as all of the risks at that time were insured and rated before electric light was introduced. Consequently they made arrangements with the electric light manufacturing company to bear a portion and a large portion of that expense. They did so reluctantly at first; they did so with a great deal of doubt. To-day more than one of them have testified to me that the expenditure thus made has been returned ten, yea a hundred fold. We have been exempt from injury to life and person in a remarkable degree. The three or four accidents that occurred there occurred purely and simply on account of the negligence and recklessness of the unfortunate victims. Our losses from fire have been so small that they are hardly worth noting so far as the loss to insurance companies was concerned. I wish to state here emphatically that the report made by the worthy fire marshal of the city of Boston to the board of aldermen that in his belief the disastrous fire of Thanksgiving day was due to electric wires, was made without due deliberation and with a wonderful lack of necessary information. Any one who knows anything about the condition of affairs there, must know that that was not the cause of that fire. I certainly do, and if I had any respect for the electrical knowledge of the worthy fire marshal of the city of Boston previous to his report, I have since lost it. Now, something as to the work of the New England Electric exchange. I was one of the promoters of that institution. Now, as to Mr. Smith's objection that a technical examination will not reach the moral character of the man examined, I will say that I know every man engaged in the electric light construction work in New England. They are all my friends, and when I find a man whose moral character or whose habits unfit him to be in a responsible position, I do not hesitate to tell him so in plain and vigorous English if necessary, and withhold my signature from his certificate, no matter how great a knowledge he possesses or how expert a workman he may be so that we have no trouble from that source. We have had since the organization of that exchange a set of men employed in construction work that in point of intelligence and in knowledge of their business cannot be excelled in this country. The time is fast approaching when the duties of the inspector must cease in New England unless he wishes to be a pensioner upon the bounty of the electric light fraternity and he has not reached that age as yet. This is owing to the hearty co-operation of the men engaged in the electric lighting business in New England. As I have stated to our executive board only a day or two before I came here, the work is now done so much better than when we began, that in many cases the duty of the inspector is simply a matter of routine; we have arrived at that happy stage by a rigorous inspection, by rejecting every piece of poor work that we could find, by impressing on the minds of those engaged in construction work the futility of attempting to palm off anything that was not first class, and in all this work we have not been obstructed in the least by the men most interested, the electric light companies and construction companies. In regard to these men who spring up in every village who have strung a telephone wire or a bell wire or a gaslighting wire, and attempt to enter this business, we have a little rule that puts a stop to them at once. We issue a circular giving the names of men authorized by the New England Insurance exchange to do construction work. A man who wishes to get on that list must satisfy us beyond a doubt of his competency and his responsibility before his name is put on, and now a person whose name is not on that circular has rather a poor chance to get rich in the construction business. There is a prejudice in the minds of the people that never should exist. Many people believe that death is present in every foot of electric wire. Many people believe that when it is introduced into their buildings their property is liable at any time to be destroyed by fire. There is no just reason why this should be believed. The men engaged in the electric lighting business in New England are as honest and as unwilling to hazard the lives and property of any of their customers as they would be to imperil their own, and the feeling that has been engendered in the minds of the public has been created largely by the sensational press of this country and is one that never should have existed and is a gross injustice to the men engaged in the business of furnishing the best light excepting sunlight, that ever glimmered on the face of this earth. It is unjust that they should be subjected to such an outrageous raid on their business by the sensational press of this country, by men who write articles, but do not know the technical difference between a wheelbarrow and a dynamo. The time will soon come when the inspector of the New England exchange will have to find some other field in which to exercise his talents. The only regret he will feel will be to miss the friendly greeting he has received at the hands of the men engaged in this business; I feel though, that in justice to the men engaged in that business; his duties will be no longer called for.

T. CARPENTER SMITH of Philadelphia: I am afraid I have not made myself as clearly understood as I should wish. I am not opposed to rules The only objection I make to the rules is that they are too complicated. What we want is a few general rules of what should not be, rather than a great many small rules of what should be done.

In regard to the other point mentioned by Mr. Brophy, I am heartily in favor of having the insurance man the inspector. I believe there are many fires that are attributed at once to the electric lighting, when if the building had been properly inspected the accident would not have occurred. We have had three cases of that kind in the last two months. In one case Mr. McDavitt went into a mill the proprietor of which was in the state of mind that the public generally is, and thought he was liable to burn out at any moment. The first thing that he saw was a large bundle of greasy waste, and he said, "You are in more danger from that pile of waste in one day than you would be from electric lights in ten years." The man we want as inspector is a man familiar with fire risks of all kinds, and I think our companies at Philadelphia show an appreciation of that fact in making it a condition of subscribing to the expense of this inspection that no matter how many other experts are employed, Mr. McDavitt should be at the head of the bureau.

MR. WILLIAMS: Although I do not profess to any practical knowledge of this subject of insurance, yet I happen to be interested in several insurance companies who in the past few years have had a large number of central stations on their books, and we endeavor to get them periodically inspected. We have found ourselves confronted with very many difficulties. We have found that while our directors in several companies were practical business men and manufacturers, earnestly inquiring into the advantages and disadvantages of electric light, yet the business itself has developed so rapidly that it has been almost impossible for us as a small combination of companies, to keep pace with that development. Your committee to harmonize electrical interests with insurance interests is well named. I do not know whether it will ever be accomplished, perhaps it may be, certainly at present these interests are very directly opposed. As one gentleman has remarked, you ask for insurance on a station, and the company simply says the rate is so much, without entering into any calculation at all. If you don't like it, you can go without insurance. On the other hand, our friends from the New England States have advanced very many strong arguments in favor of the reduction of rates. The question of the rate on the central station has not, it appears to me, been very much touched upon. There is this consideration that I would like to present. We are not altogether dependent in this country on the stock companies. I am glad to see that our friends have presented proposals for a mutual company. I hope it will crystallize into a good, solid, substantial company. The plans and purposes are in the direction of harmonizing these interests. They have taken pattern from the New England Manufacturers' Mutual companies. Perhaps it would be well to look back to those companies. We may learn something from them. About forty years ago they commenced experimenting, and they have gradually followed it along, maintaining their inspectors and confining their operations mainly to the New England States and now progressing out into the far West, and our western manufacturers, recognizing the advantages obtained from their inspections, are writing their insurance with them very largely. But all this has been done at the expense of the insurance company. They started out on the basis of the rate charged by the insurance company for insuring their mills, and they charged the insurance at these rates. They laid down

schedules, and they have gradually raised their standard until to-day, after forty years of experience they are able to return to the members insuring with them 75 or 80 per cent. of the cost. At the same time that basis rate has been reduced over 50 per cent, so that the cost of insurance as stated in this prospectus is correct. Now the New England Insurance exchange, and I want to tender these gentlemen my most respectful acknowledgments for what they have done—and they have certainly done a great deal—followed in the footsteps of the New England Mutual in this matter. For twenty-five years these companies have been favored, and are now willing to step in and take advantage of what the mutual companies have done. If we take the same ground the stock companies have taken, with the rates as they existed, it would take twenty-five or fifty years to accomplish it, because they don't want the business. Those companies want simply to look back twenty-five years, or read the experience of the mutual companies. It seems to me—and you will pardon me for speaking as a Mutual man, having spent some forty years in it—it seems to me that they are altogether too old; they move slowly and you want companies that will move with you in developing and progressing as you progress and develop. We maintain a system of inspection. We insure only manufacturing classes, and of course our inspectors necessarily have to acquire some knowledge of the electric light system. We endeavor also to have those men specially instructed by our own inspector on that very subject of the electric light and its dangers. We cannot possibly enter into the installation of wires in other buildings. It is not a manufacturing hazard with us, and so with every other insurance company.

I take it that the question narrows itself down to the insuring of central stations and power stations; and if that system of inspection is to be adopted, it seems to me the only reasonable way in which it can be done will be at the expense of the companies. The central station should be willing to pay a fair rate at the outset, and let the insurance company get its statistics from the inspectors and ascertain the exact rate at which the insurance can be carried. This is the plan that has been followed successfully in the East, and I think it can be followed in the West. Then you avoid the necessity of educating inspectors. It seems to me if this association were to undertake that it would be a very hard question. Who is to educate your first inspector and your sub-inspector? You have a mass of work on your hands that would be interminable, and certainly would not tend to harmonize the insurance and the electrical interests.

The organization of a state association seems to me to be in the direction of harmonizing these interests, but there are other things to be harmonized. If you organize a single company and send it out with the stamp and the indorsement of this association, will that tend to harmonize the other companies throughout the country. Can the association afford to do it? It is for you, gentlemen, to decide.

I would suggest that it would be perhaps well to find what companies would adopt that system of inspection, and whether that system of inspection would be such as would meet your own requirements, or whether those inspections would reach the standard that would be agreed upon by that committee on insurance. If that committee were appointed, it would be competent for them to ascertain such companies as would follow out that plan and give the members the benefit of the advantages of an inspection.

It is not merely a question of wiring. While I can indorse all that has been said by the gentlemen in regard to the defects of wiring, many devices are being introduced, some of them possibly very good, some of them excellent and some otherwise, and yet they are put in and dependence is placed upon them and the result is bad. That committee, it seems to me, should have before them, also, the question of deciding upon the value of these devices; for instance, the question of inside wiring. Very many methods are adopted. If the committee laid down a standard, of course from time to time it would be modified as the business developed, and as the means were shown that standard would be raised and companies would be encouraged, and there would be advantage reaped on all sides. There would be a means of producing harmony.

As to rules that have been spoken of, we are in favor of rules. We want rules. Nothing can work without rules, but they should be as simple as possible and be reduced to a clearly understood basis. Those rules could be formulated in this association by that committee, that should be composed of insurance and electrical men, and then every state association could adopt them and there would be no difficulty in arriving at a beneficial result.

We shall be glad to aid in the organization of the electrical mutual. We will furnish the result of our inspections and will endeavor to ascertain the dangers, and we shall expect you to assist us in avoiding those dangers.

The report of the committee was adopted.

On motion of George E. Palmer it was voted to restrict remarks in the discussion to five minutes to each person.

Secretary Garratt read the following paper:

Construction of Central Stations.

BY C. J. H. WOODBURY.

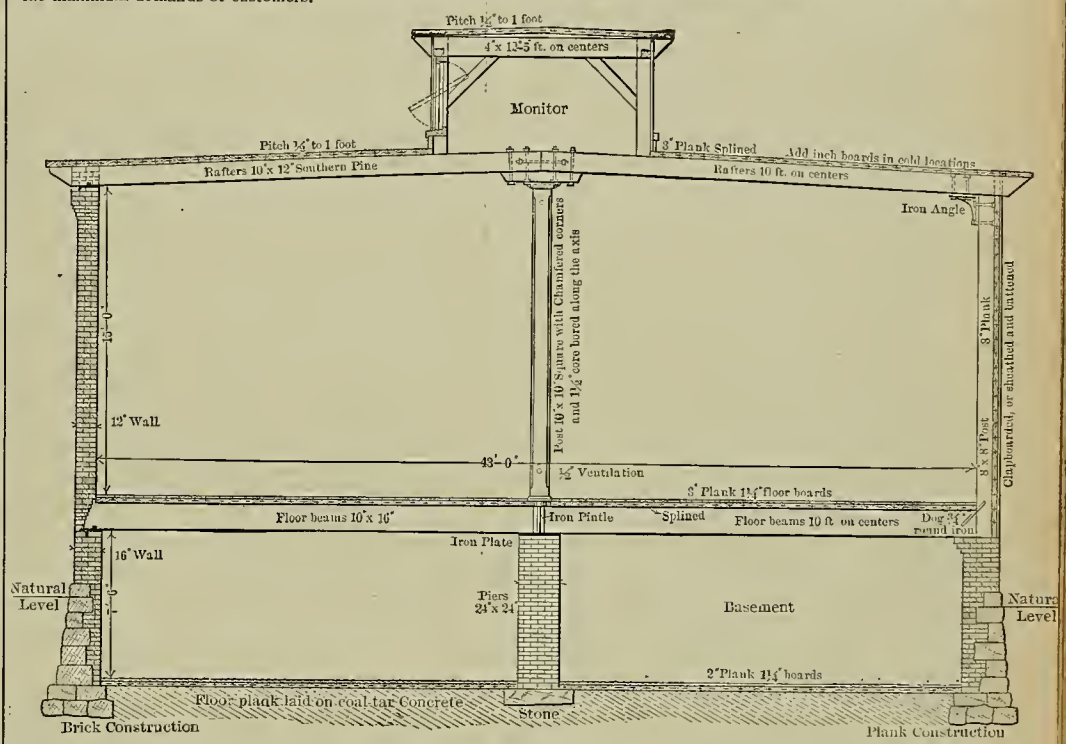
While acting in co-operation with a committee of the National Electric Light association, several years ago, it was necessary to examine into the matter of the construction and surroundings of a large number of electric lighting stations. Although these stations were built for the same object, and contained machinery and motive power devoted to the same industry, yet there was a diversity in their characteristics which was wholly inconsistent with their similarity of purpose.

In accepting the invitation of your president to present a paper for consideration at this meeting, it appeared that the subject of central station construction might be a profitable one—not by reason of what may be contained in such a paper, but on account of the valuable experience which would surely be offered by the members participating in the general discussion of the subject, and in such a connection this paper is to be regarded as the opening of the discussion, hardly more than a parliamentary necessity, in order to bring the subject into a debatable form.

Many of the electric lighting stations in large cities have been built under easy financial conditions, where it was feasible to adopt suggestions for convenience, strength and safety offered by the engineers in charge of such work. Notable examples of such stations have been presented before this association, or illustrated in the electrical journals. The opportunities for large stations have thus far been so few, and the governing conditions so diverse, that the problem requires in each instance an independent treatment, and is therefore unsuited for a general paper on the subject.

The larger part of the electric light stations are of moderate size, and were constructed under conditions of limited resources which often compelled parsimony in the reduction of first cost, and did not permit the exercise of that judicious economy which yields the greatest return on investments.

A most important element in the arrangements of a central station should be guarantee of continuous operation, in order to give patrons a necessary confidence in the stability of the service, which must be instantaneously equal to the maximum demands of customers.



CONSTRUCTION OF CENTRAL STATIONS.

Many of the stations are in close proximity to other buildings of a miscellaneous character, and are built with hollow frame walls and thin roof, forming a structure which is hot in summer, cold in winter and combustible all the year round—which disadvantages diminish dividends.

The location to be desired for a station should be, first, away from a proximity to other buildings, and therefore free from a fire hazard due to surrounding exposures. It is important that the engines should be provided with an independent condenser, but it is not necessary that the station should be near a water course to obtain a supply of water for the condensers, as is the universal custom in this country. A reservoir of suitable capacity, and not over eight feet deep, will furnish a supply for condensers, which can be used over and over; the condensed steam and hot water entering one side of the reservoir, and the supply for the condenser being taken from an extreme side. If the water should not cool rapidly enough, it could be delivered from the condenser upon the top series of several nearly level platforms, and thus flowing upon one and thence to the next in turn. In this way the water rapidly cools. Although the condensing capacity of such reservoirs might differ in this country on account of climatic differences from European practice, yet it is well to note that in winter when the short days cause the greatest demands upon a central station, the condensing capacity of such a reservoir would be greatly increased by reason of the more rapid loss of heat during cold weather.

In its general arrangements, a central station may be regarded as an engine room, and if well adapted to engines and the delivery of power, there cannot be much difficulty in providing accommodations for dynamos. The type of building suggested for consideration in its application to central station service in small cities, is the one-story slow burning construction, with flat roof, lighted by a longitudinal monitor, one end of which extends high enough to form a wire tower. It is not claimed that there is anything original in this design beyond a few minor modifications pertaining to its application to this specific purpose, for it is well known that beginning with one-story machine shops over twenty-five years ago, foundries, textile and paper mills, on the same general idea of construction, have been widely introduced, wherever the cost of land was low enough to permit the erection of a one-story structure without raising the whole cost of the floor area, including the expense of land, to a price exceeding that of a high building.

The question of foundations does not pertain to this paper, but the importance of suitable foundations is too often slighted.

Franklin once said that next to a good foundation, a good roof was the most important part of a house. The question of roof will next be considered, leaving the intervening pillars and walls for later reference.

The most convenient width for stations using an engine to every pair of dynamos is forty-three to forty-five feet, and the length of the station is in proportion to its capacity. The roof should be of three-inch plank, each twenty feet in length, grooved and splined with hardwood splines one-half by one and a half inches, and laid on roof timbers breaking joints every three feet. In colder parts of this country, liable to temperatures below zero, it is good economy to lay a course of inch boards upon the plank, with roofing felt between. Pine is preferable to other lumber for roofing, as it does not warp so much as other soft lumber, and the roof covering will last better. The roof covering may be of any material for covering flat roofs, but its value will depend upon the quality of the material and the character of the work.

If these methods are followed, such a roof can be relied upon not to give trouble by condensation of moisture in cold weather, but care must be taken not to drive nails up into the plank, because, being good conductors of heat, the heads would be cool and moisture collect on them.

Along the middle of the roof, a monitor ten feet wide, extending to twenty feet from the ends, will afford light and ventilation, while an extension of this monitor at one end to a suitable height will form a most convenient wire tower, if the monitor, in connection with an outrigger, should not be high enough for the purpose.

The roof timbers should be of southern pine, ten by twelve inches, and laid ten feet on centers. They should project eighteen inches beyond the walls, and the ends be cut to form brackets supporting the overhanging roof and forming a solid cornice. At the ridge, the two beams should be secured together by a junction bolt, and supported by column and bolster.

The walls of the station may be built of brick or of wood. If of the former, a twelve-inch wall will answer, with windows arranged as may be desired; but if of wood, each roof timber should be supported on an eight by eight inch timber reaching to the sill, and secured to the roof timber by an iron brace, and to the floor timber by iron dogs.

If the building is to be used for apparatus generating low tension currents, the best floor would be made by laying coal tar concrete on a foundation of broken stone or cinder, and then laying three-inch plank upon the concrete, and covering this plank with one and a quarter inch hard wood plank laid across the bottom plank and blind nailed to it. Such a floor would sustain any weight liable to be placed upon it, but where there is need of a mass to hold rapidly moving machinery, it could be cut away wherever it might be necessary to lay heavy foundations.

On the other hand, if the generation of high tension currents in the station imposed electrical conditions requiring a higher insulation of the floor, such as could be obtained only by an air space underneath, then it would be necessary to enter into a larger expense, and to lay a mill floor by placing the two thicknesses of planks on beams in a manner similar to the method described for the roof.

If the dynamos were placed on independent foundations,

this floor would be strong enough, but if it should be required to sustain very heavy loads, there should be a line of piers supporting the beams under these loads. The lower portion could be made into a supply room; or otherwise, the front of the building could be divided by a light sheathing partition into a supply room and an office.

In its appointments the building should be heated by two coils of three lines of one and a quarter inch pipe, each hung about three feet below the roof timbers, the arrangement of piping using exhaust steam for such a building being about one foot of one and a quarter inch pipe to every seventy cubic feet of space. Two coils are suggested because the side occupied by the steam engines would rarely need any heat from the pipes.

The roof timbers afford easy means of securing a trolley track for making any changes and removing the apparatus or parts of the engines.

The protection against fire consists principally in keeping the establishment in a clean and orderly condition, the use of good lubricating oil and careful attention to the bearings; and beyond that, numerous fire pails kept filled with water, and hose connected to hydrants ready for instant use, form the means for protection against fire.

If the boiler house is placed at one corner of the station, the latter can be extended by increasing its length; but if the boiler house is placed at the end of the station, the division wall should be made of brick and extend through the roof, entirely cutting off all wood communication between the station and the boiler room.

The wires could be run from the dynamos diagonally upward to the roof timbers, thus clearing the trolley track, and thence under the monitor from beam to beam to the switch-board on the floor under the front end of the monitor which forms the wire tower. This switch-board would be at the end of the unavailable floor space used for belts, and being in the middle of the room is away from the walls, where any combustible material is likely to be placed. It is important that the switch-board should be made of soapstone or other incombustible material.

It is submitted that a station built in accordance with these general suggestions would embody the merits of convenience in operation, slight need of repairs, and, whether built with brick or plank walls, would possess a resistance to fire which would reduce the fire hazard to a nominal amount; and although not so cheap in its first cost as might be made by using a lighter construction, yet, as a whole, it would conform to the strictest conditions of economy in a building to be used for a central electric lighting or power station.

Discussion.

M. J. Perry of Providence, R. I.: It seems to me that this paper might be more properly entitled permanent construction of central stations. It is about time that we began to look about and consider what sized central stations we shall have and where we shall locate them, with a view to permanently developing the business of producing electric currents to be distributed for whatever purposes used throughout the communities where we are severally interested in this business. On that point alone I shall offer a single suggestion.

I think I speak advisedly when I say that almost every central station man throughout the country finding his station too small has enlarged it to meet the requirements of all time, got it not quite completed, and then found it was still too small. I think we have rebuilt three times, but the last time we determined to settle that matter for a considerable period, so we bought a plat of ground 200x300, covered it about half, which with the ordinary fifty light machine would develop the dynamo room, which is 60x200, so that we would easily handle the 4,000 lights in our city. We find now we must just duplicate that.

I think there are some general lines on which it is safe for us to proceed. It is a very important point if possible to so locate your central station that if you are inland near a railroad you can run a track in and switch your coal in right by the car, or if coal transportation can be reached by water you can locate as near the water as possible and get the advantages of water transportation.

A suggestion has been made here that can be accomplished if you locate inland, to locate near the water side, so that you can erect your apparatus right alongside of the station. But the one great important point is to determine how large to build the station that it may permanently serve its purpose for not less than twenty-five years in the development of this business. One of the ideas that suggested itself to me in solving this problem was to take the total gas output of the city and on the basis of 16-candle lamps reduce it to steam power and provide for from two to three times the total gas output. Speaking to you as intelligent men, I would say buy your land now for the buildings you will erect in the future, and you will find it much cheaper. You will save more than 6 per cent., I will be bound, if I am any judge of human nature. No matter how public-spirited your neighbor may be, he will want a good round price for his patch of land. It seems to me that when you have selected your plat of land, you can build on some general lines and lay out your station to cover the whole plat, and then leave a portion of it so that it can be added to, and in the end be a completed station. So far as we know to-day, we have got to rely on steam power. There are a good many things in the air. You can say what you please about raising chickens from feathers, but when you really want chickens the best thing you can do is to depend on the eggs.

Now a word in regard to boilers. Locate your boiler with reference to this whole plat of land. Make arrangements with your engine in the same way. Then put in your first ones and follow that plan out on general lines. Now, the question as to engines is a very important one. My idea about this, that when you have determined by the rule of taking your gas outputs and divide them into about ten units, those ten engines are equally adapted to delivering the power on jack-shafts and belting up overhead, which I believe is the best way. By and by when you get along with your unit no to a thousand horse-power engine, you can drop your jack-shaft and belt right up.

As to what engine to recommend, I do not believe that I shall attempt to offer any suggestion on that point. After a careful investigation of the whole matter, and consultation with some of the more prominent mechanical engineers of the country, expert engineers, we decided to adopt, and have erected a triple expansion engine built by Allis & Company of Milwaukee. We have had it in operation now for about four months, and we have never had the slightest trouble with it. It has done admirable service, and although it has not yet been tested, it gives great promise.

The type of boiler is a very difficult thing to determine. They are very much alike, and it makes very little difference so far as the evaporation of water is concerned. A four-inch tube, whether it comes from one factory or another, will do the work.

One point I want to emphasize is this: When you set about constructing your station, it should be of a permanent character, and there should be made very large and liberal arrangements for the growth of your business. If that is neglected, there will be the universal inconvenience which has already been suffered from starting up in a hen roost or under a shed outside. I believe the loss of money in this direction is greater than in any other in central station experience. The fact is, the day has gone for that sort of thing. The man who had a common wood-saw would carefully grease it and wipe it and hang it up on a nail in a dry place, but he didn't hesitate to pay four, five or six thousand dollars for an incandescent light plant and then put the whole thing out in a shed almost without cover from the weather. The thing has been so utterly absurd that it is hardly necessary to discuss it.

The strong point I wish to bring out is the providing of ample space or ground. Buy it and own it. It is what you want for future growth and development. That is certainly a pertinent lesson that has been taught us by the universal experience of all men engaged in central station construction.

M. J. Francisco: I would like to ask the speaker if he recommends independent condensers?

Mr. Perry: We had designed for our station an independent condenser operated by an independent engine, and it had some unusual features. It is the first cut-off cylinder that was ever put on a condenser that I know of. We have been operating with that since about the middle of December, and it has been very satisfactory. We have a guaranty as to the steam or water consumed in developing a certain amount of power, so that it is to be brought down to the same level of economy as the main engine. The condenser which we are operating is a condenser designed to handle easily 2000-horse power. Our first engine is in and we have worked it up to 750-horse power, and have never had a minute's uneasiness. It has never been shut down an instant. It has operated so satisfactorily that we have now contracted with the builders, and they are at present constructing for us another engine of the same stroke, the same diameter of fly-wheel and intended to drive on the same shafting up to 1500-horse power.

The following paper was read:

The Steam Engine.

BY FRED E. SICKLES.

The theory of the steam engine has been so fully explained and is now coming to be so well understood, that it is scarcely profitable to take up the time in reiterating it here; but there are some mechanical defects in the steam engine which are yet to be remedied and which it will be well to mention. I shall not mention any one device which is covered by any patent in anything I have to say here now.

Every device that has yet been used to admit the steam and to exhaust it from the cylinder, under the general name of valves, has had its especial defects. The old-fashioned slide valve, involved a great deal of friction, and while this is meant to be remedied by balancing the valve, contrivances which have been applied to this purpose, though more or less complete, have not yet balanced the valve, as the pressure upon it varies with the position of the valve. All attempts to balance the old-fashioned slide valve with the rigid fit, without elasticity or some yielding arrangement, have proved failures. As in first applying the steam and warming the engine, the valves will warm faster at first than the surrounding steam chest and will jam if care is not taken to give ample time for the equal warming of all parts, any want of care on the part of the engineer in this respect will tend to work injury by the cutting of the valve when first starting the engine. In that form of piston valve, which has piston range, either one or two, the liability of leakage, past the ring is encountered, especially as those rings cross the ports of the cylinder; and when attempts are made to work pistons with solid rings, then the difficulty of expansion is encountered. If a solid piston is used in the piston valve, it becomes necessary to make the piston slightly smaller than the bore of the seat to allow for the unequal expansion when first starting the engine.

The many ported slide valve gives ample opening with but little motion, but it has extended edges to permit leaks, if not carefully fitted. The rotating slide valve with a raised seat is difficult to get at, to keep tight although it presents some advantages in connecting the valve motion to it. With balanced poppet valves the difference of expansion between the valves and chest is liable to create a leak, but if great care is exercised in fitting this kind of valve, and an ample guiding surface is allowed above and below on the stem, and the seats are made of not more than an angle of 22 degrees from the vertical line, with the valves and chest cast of metals of substantially the same rate of expansion, the valves can be made to remain reasonably tight. Yet, if great care is not taken in the adjustment and shape of the rock shafts for opening and shutting the valves, they are liable to make an unpleasant noise when running at any rate of speed. The single poppet valve can readily be made to work tight for a reasonable length of time, but there is the same objection to it as in the double poppet in regard to making noise at high speed. In addition to this it requires heavier valve gear, because, just at the instant of opening it offers great resistance. They do not waste as a whole, as much steam as the double poppet valve. They can be arranged to have less clearance between the cylinder and valve. Indeed, single poppet valves have been placed directly upon the cylinder heads, thus giving very slight clearance. This plan has not come into use, owing probably, to want of proper adaptation of the details of the mechanism. The whole subject of valves for steam engines presents a field for ingenuity.

It may be expected that the speaker will give some account of the trip cut-off valve, with which his name has been identified for one half of a century. To do so fairly I shall have to state the requirements of a perfect cut-off, which really cannot be secured, and the trip cut-off is only an effort to reduce the loss occasioned in working the cut-off. To describe this loss I will state that steam may be assumed to have two different powers. One power is derived from the force it exerts in pressing against the piston as it escapes from the boiler into the cylinder. The other is the force it exerts after communication has been cut off between the boiler and the cylinder in expanding and continuing to exert a diminishing pressure upon the piston. When the steam has exerted nearly the whole boiler pressure at one-fourth of a stroke, and it is then desired to cut off the steam so as to obtain all the power that can be derived from the expansion of the steam already in the cylinder, the communication between the boiler and the cylinder would have to be instantaneously closed, so that the power derived from expansion in the cylinder might begin at nearly the boiler pressure and continue to exert a diminishing force to the end of the stroke. Any mechanism yet devised cannot instantaneously close the opening, for two reasons. First, it would be impossible as far as we know, to put any machinery in motion sufficiently rapid to instantaneously close the opening; and second, if this rapidity of motion could be obtained, it would be impossible to absorb the momentum of the parts in arresting this very rapid motion. The best we can do in this regard is to devise some arrangement which will move as fast as it is practicable to move mechanism, and then absorb the momentum of these parts in such a manner that no destructive violence will occur in arresting their motion. In the trip cut-off, the valve is liberated from the opening mechanism and is forced shut by a spring or elastic force, as shown in the original patent; and in fact, in the original patent, the elasticity of the spring and the elasticity of the steam are used to force the valve shut as rapidly as it is practicable to do so. The mechanism for absorbing the momentum of the parts may be explained by referring to what we see every day. We see that water and air in their action upon the earth disintegrates and destroys its surface, in time, while neither the water or air is injured by the violence. All the storms that have beaten upon the ocean have not injured one drop of water, while the air and water have washed and disintegrated the shore line of all the continents. Hence, it is reasonable to infer that if the violence of the momentum occasioned by the use of the trip cut-off on rapidly closing could be absorbed in the motion of a fluid, whether water or air, a practical working machine would then be secured. It is only necessary that the valve in closing shall work some device like a plunger or piston which shall have this property, viz: That it shall move freely in the fluid while the cut-off valve is closing, but at the moment of the closure it shall encounter the fluid by confining a portion of it. How is the power lost in the case of a locomotive that at one moment is developing 400 horse power with full boiler pressure and having been suddenly flagged to stop is during the next minute exerting no power through the cylinder (in the meantime the pop valve has jumped wide open and steam is escaping violently through it)? The power of the steam is lost after the engine is shut off in forcing the particles of steam past the blow-off valve into the open air. In the same way, while the cut-off valve is slowly closing, the power is absorbed in forcing the particles of steam past the cut-off valve. It might be well for those who have yet to believe in the efficiency of the trip cut-off, and among these are some of the very best mechanics of the present day, to try the part which I presume they will have the most doubt about, that is, the checking apparatus or dash-pot. If they will make a controlling vessel so arranged that it will permit the fluid to escape freely until it is desired to arrest the momentum by confining a portion of it and forcing it through a narrow orifice of any sort, and will watch its action by letting it run in a shop or other place for any length of time, they will be entirely satisfied as to the reliability of the checking apparatus. In regard to the tripping apparatus, one objection is the use of a spring in the valve motion of a steam engine. It may be well to mention that it is not necessary to have a spring, as a weight will answer to re-engage the trip, or a positive motion can be secured; but springs or weights are generally used and as springs are shown in the original patent, it may be well to consider the question of springs. The elasticity of metal is one of the laws of metals, as fixed as the law of gravity, and much of the prejudice against springs has been created by using them beyond their safe elastic limit; and when this is done, then the spring becomes

an unreliable means of working mechanism. This fact may be illustrated by referring to an ordinary watch. The main spring of a watch frequently breaks, but the hair spring, never. Yet the hair spring is put to tension and compression from three to five hundred thousand times in twenty-four hours. And the reason is, the main-spring is taxed beyond its safe elastic limit, and the hair spring is not so taxed. In cases where springs are used, if this consideration is kept in mind the spring can be made reliable within a reasonable limit. By applying this mode of reasoning to the trip cut-off, the remedy is obvious. The force necessary to re-engage the catch is so very slight, it is quite easy to make a spring that in performing this office, while not nearly taxed to its safe elastic limit, can therefore be relied upon with reasonable certainty, to work the catch. If any good mechanic may yet be in doubt as to its certainty, it is an easy matter to add another spring and catch, so that one will act in case of failure of the other. This was the plan adopted in the original patent to overcome one objection that was anticipated against the use of the spring in working any part of the valve motion in the steam engine. An examination of the model in the Patent Office under date of May 20, 1842, will show these double springs. It is difficult to change the opinion of any mechanic except by illustrating. As there are now no patents upon it, it is public property. Probably the best way for inquiring engineers would be to test the catch or checking apparatus, and it will be found that they are entirely reliable as a practical question.

In cases where the trip cut off is required to act at all points of the stroke it is best to use it in connection with the patent of Sept. 19, 1845, granted to the speaker, which has been variously termed "Independent Motion," "Universal Motion" etc., as it works the trip at any point of the stroke of the engine. This inventton is in use on the steamers of the Fall River Line running on the route between New York and Boston, and many other vessels. It has lately been used on some boats on the Western rivers under various names. When the trip is worked by the valve motion, as shown in the patent of May 20, 1842, it is best to limit the motion of the tripping piece so that the cut-off will always act and not allow the steam to follow the full stroke by the excessive vibration of the governor.

The speed at which a trip cut-off can be made to work will depend somewhat upon the arrangement of the mechanism. The lighter the parts involved in the motion, the more rapidly they can be made to work with ease. A large steam engine with large heavy valves has been made to work at the rate of 120 revolutions per minute, and indeed it would be hazardous to limit the speed at which a trip cut-off can be made to work as, with the proper closing force and the proper absorbing vessel for the momentum, the speed of closing can be carried far beyond anything yet in use. But the cut-off is only a part of the engine. The motion of the steam valve in opening to work smoothly with the greatest power should be such that, while it moves, to give only a slight opening at the beginning, so as to gradually apply the steam as the engine passes the center, this gradual opening should change into a rapid one followed by a rapid motion of the valve in cutting off the steam. The motion of the exhaust valves should be rapid in opening and rapid in closing, and one exhaust valve can open before the other closes, providing some means are secured to gradually apply the steam to the engine as it crosses the center. But in practice there are only a few instances in which this gradual application of the steam has been used. I will mention one case in the speaker's practice. The Steamer Pilgrim, having an engine with a diameter of cylinder of 110 inches and a stroke of 14 feet, carrying pressure of steam as high as 45 pounds per square inch, was required to be altered from a Stevens valve gear to a trip cut-off, and it was necessary to retain the faulty steam connection between the boiler and the cylinder and the faulty surface condenser and do the best the circumstances would permit. To remedy the faulty condenser in part, the exhaust valves were arranged so that one was open 1½ inches before the other closed, to afford the greatest possible time in which to condense the steam from the cylinder, and this prevent any attempt at cushioning. It was necessary in working the steam valves of the new arrangement to so graduate their opening at the beginning of the stroke as to avoid any shock or jar that might come upon the engine by reason of the application of steam. As the valve gear was very heavy, involving tons of metal, the spring of these parts would tend to increase the sudden admission of steam, notwithstanding any gradual movement that might be attempted upon them. A plan was resorted to of opening the steam valve an adjustable distance, say ⅛ of an inch, and then stopping all further motion for a short time so that the spring of the heavy parts of the machinery should not act by their elasticity to increase the opening. After the engine had crossed the center the further opening of the valve was commenced and continued until the cut-off acted. The entire distance of opening both steam and exhaust valves was 6½ inches in this case. The indicator card still showed a defective condenser and defective steam connection, and it also showed what appeared to be a slight cushioning; but this appearance was deceptive, as the real cause was, the steam passed around from one side of the piston to the other as one exhaust valve opened rapidly before the other closed, and the slight delay occasioned by the use of the faulty condenser increased this apparent cushioning upon the card. There could be no cushioning, because both exhaust valves were open, until the piston arrived at each end of its stroke. But the problem of applying to an engine of this size in the hull of a steamer without creating a jar had to be solved and this was done, as before stated, by a careful adjustment of the steam valves in opening so as not to apply the whole of the pressure at once. The first admission of steam in this case is marked by the sound of a squeal, indicating wire-drawing at the first motion of the steam valves. The indicator card shows a curved line on the admission end, proving the gradual application of steam. This was the best that could be done under the circumstances, and it was found effective in making the engine work smoothly while the main connections were quite loose, and saved a large amount of fuel by the rapid cut-off. No doubt she may still be seen running in the summer between New York and Boston on the Fall River Line.

Any inquiring mechanic who desires to test the question of whether it is possible to prevent a jar by the gradual admission of steam, can do it in this way. He may put a very small valve upon one end of the cylinder of a steam engine and make arrangement to give it an opening and closing motion. Then, if he will set this engine to pound on both centers and subsequently adjust the opening of this valve he will find that it will take the pound off of one center, in which it admits steam, by properly adjusting it, and in this way be convinced of the efficacy of the gradual application of steam to prevent a concussion upon a center. Mechanics as a rule must depend upon themselves. The assertion of a fact by another is no proof to them, and hence I have stated a way in which they can satisfy themselves of the efficacy of the gradual application of steam. There are, however, many forms of valves in which this method of the gradual application of steam cannot be well embodied without too much complication and for very large engines it might be well to apply separate small valves to ease the engine on the center.

In most cases dependence has been placed upon what is termed cushioning to make the engine work smoothly, by shutting the exhausts before the completion of the stroke and allowing the steam yet remaining in the cylinder to be compressed. It may be said that all high speed engines of the present day use this plan to avoid pounding on the center. Locomotives and high speed stationary engines depend upon the compression of steam to avoid a pound in the reciprocating parts. This compression necessarily absorbs a certain portion of the power of an engine, but it can be relied upon to secure smooth working. The price of coal, the interest upon money, and the cost of reliable attendance are to be considered in determining the best plan as a money consideration. This last remark is true in considering the construction of every part of the engine. A perfect valve has not yet been made, a perfect cylinder has not yet been made, a perfect packing of cylinder has not yet been made, a perfect valve motion has not yet been made, etc., etc. The packing of the piston should be such as that it will work without friction, automatically adjust itself to the wear and to the irregularities in the bore of the cylinder, and also to the different temperatures of the piston on the cylinder upon first starting the engine, and it must be tight. If the rings are made, as the speaker has sometimes made them, with an adjustable catch to hold them from being thrust out by a spring so hard against the cylinder that the steam could not force them back, then as soon as any wear takes place, this catch will act to prevent the rings from following out the wear, and thus a leak will be created. Great care is required to manage an adjustable catch. Now, if the catch is not used and some force is applied to keep the rings out against the cylinder as is usually the case, then if the steam leaks by the rings and gets between the cylinder and rings, it may force the rings back and create a leak. If the spring is set so as to hold the rings out against the cylinder, and to resist the tendency of the pressure of the steam to force them back then a great friction will be encountered between the rings and cylinder and if the steam should pass behind the rings, it will force them out against the cylinder with additional pressure and thus add to the friction. If an arrangement such as has been made is used to present a smaller area to the steam behind the rings, than exists on the face of the rings, then the steam in passing behind the rings and forcing them out, may be met by the steam which has passed down between the rings and cylinder, this steam acting upon a greater area, may overcome the steam forcing them out and forcing the rings back, thus creating a leak. Indeed it may be said that mechanics are almost in despair of producing a perfect piston packing. They have turned grooves in the piston, and in these grooves have inserted other packing rings but after all the difficulty exists, in that the steam is liable to force them in or out. If they are forced out it creates undue friction. If they are forced in, a leak is permitted. If any attempt is made to have a fixed ring, in the sense of preventing it from being made either larger or smaller, then the danger of more rapid expansion of the piston is met upon starting the engine. The difficulty of obtaining proper adjustment with ordinary attendance is met, so that a perfect piston, one that is automatic in its adjustment and comparatively frictionless and tight, as before stated, has yet to be made; all parts of the engine are imperfect. A realization of the imperfection of any machine may lead to the way to make an improvement upon it; it is therefore instructive to search for defects in the steam engine.

A perfect lubricating arrangement for the journals, one that can be relied upon in all cases, has yet to be made; of all the various forms of valves each has its particular disadvantage, and there yet remains to the inventor a wide scope in which to engage his efforts. But in determining upon any plan, he is met at once by the consideration, that a plan that might be good in one place would not be good in another because of the difference in the interest on money and the price of fuel; and perhaps in another place the difference in the price of fuel, and the price of efficient attendance. In another place the difficulty of securing proper repairs, as for instance an engine in the mining regions, may be met. So it is quite impossible to give any specific directions for the construction of what might be called a universal steam engine. Perhaps in some future day some one will make a steam engine which will secure fully, economy in construction, economy in regard to fuel and efficient attendance, but certainly no such machine has yet been made.

As the cost of efficient attendance diminishes, probably an increase of efficiency of the steam engine can be secured. A machine that will work well in the hands of one person will sometimes prove a failure in the hands of another, and a construction engineer is constantly harassed by the question: "Who is to take care and run this engine which I am now planning?" "and how far can I rely upon efficient attendance?" and as often as he decides these questions he decides to some extent the character of the engine which he considers best for the purpose. Users of steam engines naturally desire to have their engines so constructed that they need not continue in their employ any particular engineer, but can change employes without danger to the success of their engines. Users consider this fact in determining the kind of engines to purchase.

A perfect governor for general adoption has not yet been made. All forms of governors in use depend for their action upon the change of speed of the engine, and when a small amount of steam is required to drive the engine, the governor must necessarily move faster to diminish the supply of steam, either when applied to a cut-off or to a throttle valve. When the governor receives the impulse to run faster, the working parts of the governor are restrained to some extent by the force transmitted through them to increase its speed, and hence at that moment, it is not as free to act as it would be if no such resisting friction were applied to it, and yet at that very time the governor is required to move and the result is it does not move at first, until sufficient additional speed has been imparted to it to overcome the friction created by applying the force necessary to create this additional speed; and when the governor moves the friction having been diminished by reason of the driving force being less, it has a tendency to move freely and shut off the steam to too great an extent. Various appliances have been made to correct this by preventing the governor from moving rapidly in any case, but when this is done the governor may not move with sufficient rapidity to check the engine when the load is suddenly removed. Then again the parts which have to be moved have more or less friction in themselves, and the greater this friction, the greater the tendency to obstruct the free movement of the governor. We see in practice that unless a comparatively large amount of momentum is secured either by high speed or by a large fly wheel, there is a great tendency of vibration in the motion above and below the required point. To overcome this the speaker at one time combined a governor arranged to receive its impulse through a driving arm and roller, so as not to materially impair its sensitiveness, and then this governor acted upon the differential motion patented by the speaker, which in fact separated all the force necessary to work the parts operating on the governor, and thus the governor was as sensitive as the pendulum. But this arrangement was too delicate for ordinary attendants and was only resorted to in this case because of the peculiar surrounding circumstances. The patent on this arrangement has expired. It may come into use in some future time when the advantages of a very accurate running engine are more appreciated, and when the cost of efficient superintendence is less than at present. I may mention that so perfect was this engine that on one occasion when the driving belt broke the engine continued to run so nearly exactly on speed that the difference could not be noticed. It is possible to make an engine do this, but it requires great care in the construction of the parts of the governor and the differential motion and power cylinder attached to it. It also requires that all the incidental slack that may be in the parts between the first motion of the governor and its final application through the differential motion and power cylinder shall be provided against, by either a weight or a spring which shall hold all this slack constantly in one direction, for this slight slack will still affect the action of the governor if it is allowed to act irregularly. Perhaps the best practical solution of the governor question at present, is to provide a very large governor, running at high speed, so that a very little change in the motion of the governor will effect a very great change in the amount of steam applied to the engine; then if this governor is driven by arms which bear against rollers inserted in the balls or weights in the case of centrifugal governors so that these arms drive the balls or weights faster or slower through the interposition of a delicately-made steel roller, that permits the balls or weights to move freely, when any additional force is applied to them, a much greater accuracy of regulation can be obtained than is usually found in practice, provided care is taken that all parts necessary to be moved to control the motion wheel have very little friction. It would be difficult to explain the whole matter without drawings, but I have endeavored to state the principles, which can, of course, be carried out by different mechanics. Governors for steam engines have been made in various ways, but nearly all of the kind which I am about to allude to have passed out of use, and I can best describe them in a few words by stating the principle upon which they were built and leaving the special designs out of the case. One form of governor was made by first generating a uniform motion, and this uniform motion was generated in different ways by different persons. One used a uniform motion acting upon a uniform resistance; another used a varying force upon a varying resistance and secured a nearly uniform motion by a gov-

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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In this issue will be found a complete stenographic report of the Kansas City convention of the National Electric Light association. The convention was in every way successful. It seemed to be generally conceded that the meeting was one of the most interesting and instructive ever held by the association. The papers, several of which are mentioned in succeeding paragraphs, were of an eminently practical character and were of a high order of excellence. The arrangements for the entertainment of the delegates were very complete, and altogether apart from the regular sessions of the convention the visitors had a most enjoyable time. The success of the convention was due in no small degree to the hard work of President E. R. Weeks. He labored zealously to make the convention of practical benefit to the members, and he deserved the hearty congratulations which he received.

One of the most significant papers read at the convention was that of Frank Sprague on "Electricity as Applied to Street Railways." The paper is well worthy of a careful perusal. The points which he makes in reference to the merits of the litigation between telephone and electric light and power companies will be read with special interest at the present time.

It has been stated on what seemed to be competent authority, that the conflagration in Boston on Thanksgiving Day was due to the crossing of electric wires. Such, however, was not the case. Capt. William Brophy, the inspector of the New England Electric exchange, stated in the convention that although the fire marshal of Boston had announced the cause of the fire to be due to the crossing of wires there was absolutely no reason for believing that such was the case.

At the National Electric Light convention George M. Phelps reported for the committee appointed to memorialize congress to abolish the customs duty on copper. After speaking of the work accomplished by the committee, he advised the members to address to their representatives in congress letters calling the latters' attention to this important matter. If a discussion on the merits of the question on the floor of the house could be brought about, Mr. Phelps thought the success of the petition for the removal of the tariff would meet with success.

"Hot in summer, cold in winter, and combustible the whole year round," is C. J. H. Woodbury's description of many power plants in his paper on "Construction of Central Stations." Happily investors in electric lighting plants are beginning to realize that in order to operate a station successfully the machinery must be placed in a suitable building and given proper care. At present much attention is being given to the architectural design of central stations, and many interesting and timely suggestions are presented in Mr. Woodbury's paper.

Managers of electric light stations are beginning to realize that permanent success can only be obtained by conducting the business of central stations on sound financial principles. At this time any suggestions that will tend to add to the commercial success of electric lighting will therefore be received with attention. T. Carpenter Smith's paper on station accounts points out a way in which the expenses may be reduced and the receipts largely increased. His system is carefully worked out in all its details, and will undoubtedly be approved by experienced managers as it is thoroughly practicable.

The annual address of President Weeks at the Electric Light convention, was listened to with interest. After speaking of the good work done by the Electric Light association and of the necessity of discussing practical subjects, he referred to the organizations of state electric light associations. These organizations, he said, could hold meetings which could with advantage take the place of the summer conventions of the National association. This suggestion met with general approval of the delegates. Referring to the prospects in the electric light field, Mr. Weeks said advancement in the near future, was to be in the line of economizing present waste, rather than in the discovery of new principles. The president then alluded briefly to that popular topic, safety and electric lighting. It was not enough, he said, that electric lighting was comparatively safe. The public, he thought, had a right to demand that regulations for safety keep pace with the development in other directions. Mr. Weeks' final suggestion was that electric light companies settle their controversies amicably, and so save the expense connected with protracted litigation.

A matter of no little importance to central station men is the report of the committee which was appointed at the Niagara Falls convention for the standardizing of potential for electrical apparatus for street railway systems, in which the announcement is made that the Thomson-Houston and Sprague companies have agreed to use a standard potential of 500 volts upon all electric railway lines that do not require special apparatus for successful operation. This is certainly an important concession, and the committee is deserving of much praise for the persistence displayed in collecting data, etc., and urging the advisability of this course. There are many other excellent points in this report, which will prove valuable to central station managers.

"Economical Generation of Steam for Electric Stations," is the title of a paper presented by Geo. H. Babcock before the convention. In view of the author's high standing in his profession and also of the fact that the present tendency is toward a refinement in the construction of the steam generating apparatus in electric light plants, Mr. Babcock's paper merits a careful perusal. In the beginning attention is called to the peculiar conditions which control the question of economy in the generation of steam in an electric light station. "For the production of steam," says Mr. Babcock, "we require fuel, furnaces, boilers and brains—the last not the least, by any means, when economy is the aim." Referring to the trying position in which many buyers of boilers must be placed on account of a want of scientific knowledge, a number of valuable suggestions are offered. The writer urges that in the selection of the elements of an economic plant the "co-efficient of common sense" should be fully employed, and that "facts gained from long experience are a far safer reliance than were assertions not backed by years of practical results."

Those in search of information as to the actual risk to life and danger of fire from electric light conductors, will do well to read Prof. Elihu Thomson's paper on "Safety and Safety Devices in Electric Installations." It is evident that Prof. Thomson in preparing his paper made an effort to treat the subject with impartiality. To quote his own words from the introduction of the paper, he has "no sympathy with any effort tending to impress a false estimate of such risks, or tending to give the impression that they are absent when in reality they are existent." Prof. Thomson takes the position that the high tension current has a place which the current of low pressure cannot fill. "We must," writes the author, "convey electrical energy by moderately high electrical pressure, so as to avoid prohibitive losses." The evils of poor construction are pointed out, and the usefulness and necessity of safety devices to provide for abnormal conditions, are emphasized. A number of safety appliances are referred to, and their merits discussed. In the low potential multiple arc systems, Prof. Thomson considers it an excellent plan to run the two branch wires, excepting the larger ones of the system, close together, provided they are encased in insulation and covered in. By this construction in case of leak from main to main, the fuse is liable to blow before the small amount of combustible matter between the wires can ignite. As it has been the usual practice to keep the wires apart rather than close together, Prof. Thomson's suggestion is a departure. Whether it will meet the approval of insurance men is a question.

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ernor; then this uniform motion thus generated, was applied to control the motion of the engine by interposing between the uniform motion and the motion of the engine a lever or cam so arranged that the steam engine varying this lever or cam in shifting its position would apply more or less steam, and thus the engine was controlled to run with the speed of this independent uniform motion. Another form of governor was made on the principle of moving a body in a fluid, and as the resistance increased by reason of the increased velocity of the steam engine, a spring or weight was moved and by its motion the admission of steam was adjusted to control the speed. But it is questionable whether it is not the best principle to have what amounts to a substantially powerful governor, as before stated, so that a very slight motion of this governor will be sufficient to regulate the admission of steam to control the speed of the engine; care being taken to secure almost frictionless action of the governor in its movements, and to separate any load involved in the action of the parts to control the steam so that the governor may act as nearly as may be like a pendulum beating time. And, indeed, the point to be reached as before stated, is to cause the governor to be as sensitive as a pendulum of a clock, and to be free from disturbing influences.

Governors have been applied to cut-offs from the early part of this century; as early as 1812. As the trip cut-off required but little power to change the rate of expansion, it was well adapted to be operated by the governor, and its frequent use for that purpose has stimulated users of the different kinds of cut-offs to connect them to the governor with more frequency than was the general custom before the trip cut-off was invented. Almost any form of cut-off can be controlled by the governor, provided changing the cut-off does not bring too great a disturbing force upon the governor.

In regard to the steam engine of the future, if a metal is found that will enable steam of, say, 1,000 degrees to be used and the escaping heat from the first boiler to be used in evaporating water to feed a second engine at 500 degrees, and then to a third engine that will make the draft by drawing the heated products of combustion through water whose evaporation will supply a working cylinder that derives its power by receiving the steam below the atmospheric pressure and expands it to the lowest effective limit before discharging into a condenser,—then we will have a combination using much less water per horse power than any engine yet made; but it does not follow that such an engine will be the most economical, as that will depend upon the interest charged for the use of money and the price of fuel, as it would cost more per horse power to build such an engine than one working under ordinary conditions. With money at 6 per cent. per annum and the cost of fuel to evaporate one ton of water at $1, a certain plan would be advisable. Again, with the money at 3 per cent. per annum and the cost of fuel to evaporate one ton of water at 50 cents, the same plan would be good, but as the cost of money and the cost of evaporating water change relatively, the best plan for economy in a steam engine would necessarily change to obtain the most economical result in the use of money. The cost of room for the plant and the cost of water for condensation, together with other contingencies, must be considered in any plan for a steam engine that is to be adapted to the surrounding circumstances under which it may be required to work.

The cultivated human eye and ear are wonderful natural indicators to determine the working of many parts of a steam engine. By watching any moving part of the engine and listening to the sound of the steam in the steam pipe, a good idea can be formed of the point of cut-off. By a closer attention to the peculiar sound of the rushing steam, the efficiency of the cut-off can be partially determined. By listening to the sound of the exhaust and watching the crank-pin, a good idea can be formed of the lead; then by a closer attention to the peculiar sound of the exhaust, such as the time during which it can be heard, a fair idea can be formed of the exhaust line as it will appear upon the indicator card in this case. By a close attention to the motion of the reciprocating parts of the engine in crossing the center, the effective lead on the steam valve can be ascertained, particularly if the engine is not set to cushion largely on the exhaust.

The human touch will reveal relative motion in continuous parts of machinery that is beyond detection by the eye or ear; as, by placing a finger on two pieces that are apparently firmly in contact, a motion will sometimes be felt that is not visible.

By cultivating the eye and ear and human touch to help in judging machinery, every engineer will be filled with a reverence for the marvelous powers of the human machine of which he is master.

Some blind persons can by the sense of touch in their tongue guide a thread into the eye of a needle. Some watchmakers can ascertain if a watch is running accurately within reasonable limit by holding the watch to their ear and at the same time watching the vibration of the pendulum of a standard clock. The carefully trained pilot in a fog or dark night will depend upon his hearing to tell him when he is approaching an invisible object of any considerable size which projects above the water, as he will instantly notice a change of echo of the noise made by his vessel. Some engineers, trained to the sound of their engine, will notice a very slight difference in the working of any part by the change of sound, even when they are engaged in other work and apparently not listening to any noise.

To speak upon the steam engine generally is to endeavor to embrace a subject that has almost infinite aspects and embodying innumerable plans of different men with fertile imaginations and ingenuity. The speaker has only endeavored to present a few views of the case in a short statement. The subject is too vast for complete treatment, and the life of an ingenious inventor can be occupied with efforts to improve only one part of a steam engine, and at the end find a vast space is left for further improvement.

The use of words to describe machinery, without the aid of drawings, must at present be unsatisfactory as all of these words have meanings attached to them formed during a former civilization in which but little machinery was used, and the special sense in which they are necessarily employed in this statement must be understood before the intended meaning can be apprehended. A knowledge of the ancient and modern languages will afford no certain assistance in determining the meaning of words as used by mechanics in the absence of knowledge of the special meanings attached by them in describing details or mechanical operations. The dictionary depends mainly upon the leading authors for the meaning of these words, and probably they only knew them as associated with ideas entirely outside of all engineering or mechanical connections. When in the progress of improvements, a complete dictionary is established, giving the meaning attached to words as applied by mechanics or engineers in describing machinery, it will then be easier to describe by the use of words alone any mechanical operation so as to be more readily understood. At present it is like taking a cold chisel to do the duty of a screw-wrench in many cases when employing words to describe machinery. In the decisions in the patent cases before the court it has been wisely held that every patent is to be construed as meaning what is to be gathered from taking the drawings and words together, or, in other words, each patent furnishes its own dictionary. And it is reasonable to assume that the words the speaker has used in an effort to describe some parts of the steam engine will be taken to mean differently to some extent, by different engineers or mechanics.

It is with some regret that the speaker is obliged to consider what he has stated as necessarily unsatisfactory, the pressure of professional engagements having prevented a careful preparation. A conference like this is well adapted to bring out facts, when, by the exchanging of views on various points, a much better understanding of the opinions of members can be secured for the benefit of themselves and all other interested parties.

On motion of Mr. Francisco the meeting adjourned until 9:30 A. M. Thursday.

Thursday Morning's Proceedings.

The convention was called to order by President Weeks about 10 o'clock. Mr. Weeks announced that the badge of the organization entitled members to free passage on the lines of the Inter-State Rapid Transit company, and the Metropolitan Street Railway company.

George H. Babcock's paper "On the Economical Generation of Steam for Light Stations," was read by George E. Palmer as follows:

Economical Generation of Steam for Electric Light Stations.

BY GEORGE H. BABCOCK.

In the early days of the introduction of water-tube boilers we were frequently met with the remark: "Oh, they may do very well for woolen mills, but have you any in use in a cotton mill? How do I know they will answer for that purpose?" or: "Yes, they may be very economical in a sugar refinery, but when you come to driving engines and steam hammers that is another thing; they won't do for that." Of course, the answer to such objections was that steam was steam, and that which made steam most economically for one purpose would do the same for any other purpose—the steam caring nothing whether it was used for refining sugar or driving engines for making flour, cotton or woolen cloth, or rolling iron. But, notwithstanding the plausibility of this argument, it is not quite true, for the work to which steam is to be put, and the circumstances under which it is to be used do in a measure control the conditions under which economy in its generation is to be secured. For instance, the most economical steam generator for railway locomotion would be a wasteful and inefficient apparatus for ocean navigation; steamship boilers and furnaces could not be recommended for factory purposes, nor would the best of stationary boilers answer for a steam fire-engine.

There was, therefore, good common sense in the choice of the subject upon which I was requested to address you. The equations which determine the highest economy in generating steam for electric lighting purposes are different from those which would solve the question of economy on a steamship, a locomotive, a fire engine, or even for an iron works, or a cotton mill, though many of the same quantities and much of the notation may be the same.

We need therefore first, in considering this subject, to ascertain the peculiar conditions which control the question of economy in electric light plants, and wherein they differ from those of other power stations. These conditions are:

First. The amount of steam required is not only quite variable, but is subject to unlooked for and sudden changes, which changes are in no way under the control of the management. In places like rolling mills, sugar refineries and dye works, where sudden changes in demand are frequently met, these variations are quite under control, and may be frequently delayed or avoided to favor the boiler house, but in electric lighting they can only be met by either supplying, or failing to supply the demand. The steam plant must therefore be one which will permit of quickly changing the supply to meet the varying requirements.

Second. The maximum demand is for a short period in each day, at the best. A curve plotted to show the output of electricity in a station having a good patronage will show considerable variations day by day, but always a mountain peak at about the same hour. This is peculiar to electric lighting and has much to do with the question of economy.

Third. An electric light station must be always on hand ready for work. It cannot take a vacation at the pleasure of its proprietor, the whim of its operators, or even the attending of repairs. A break down not only stops its own work, but that of many others, and jeopardizes often great and grave interests. Providing a plant therefore with apparatus liable to break down or difficult to repair, no matter how cheap in first cost, or economical in the use of fuel, would be in the homely language of the old adage, "saving at the tap and losing at the bung-hole."

In studying the question of economy in generating steam for electric light plants, it is quite necessary to take all these conditions into consideration, in order to arrive at a proper solution, and to that end we must consider their controlling effect upon certain other elements which are common to all steam plants.

For the production of steam we require fuel and furnaces, boilers and brains—the last not the least by any means, when economy is the aim. Let us take these up in order and inquire what the effect of the environment has upon their selection.

First, Fuel. This is a word which covers a multitude of substances, and locality has very much to do in determining the choice as to what fuel is best to use. For instance, in Bogota rosewood is found economical, in some parts of California peach stones are used, while in other places saw-dust, peat, wood, bagasse from sugar cane, spent tan bark, straw and numerous other substances compete with coal on the score of economy. Of coals we also have a great variety, and great differences in price. Anthracite, for instance, varies in price from $16 per ton in some South American localities, to 10 cents per ton, the price which the electric light station in Scranton pays for the use of the mountain of fine coal at its back door. Of bituminous coals there are numerous qualities, some of them worth fully double others for steaming purposes—but frequently the local coal of poor quality is cheaper than better coal brought from a distance. It is therefore necessary to determine this question for each individual, bearing in mind always that the cheapest in price is not always the most economical, and leaving the local circumstances to decide.

Second, Furnace. The kind of fuel having been decided upon, the furnace needs to be adapted thereto. No one furnace is best for all fuels, and rarely for more than one. For anthracite a plain furnace with a grate fine enough to suit the size of the coal, and with the greatest possible air space, is excellent, and amply sufficient when intelligently fired. When however, you attempt to burn bituminous coal in this same furnace you get poor results and abundance of smoke. The same furnace, however, may not be suitable for two different bituminous coals, and it requires great experience to be able to determine just what furnace is best in each case. And just here one of the controlling conditions already referred to of the peculiar environment of an electric light station comes in to modify the selection. It is to the furnace we must look largely for the ability to meet the sudden fluctuations in demand for steam. After the fires have been sluggish for a time on a small demand, it becomes necessary to almost instantly freshen them up to vigorous action. Hand firing and natural draft do not easily meet this requirement, and here arises also the greatest difficulty in the employment of automatic stokers in electric lighting stations; they as a rule do not admit of sudden changes in the activity of the fires. There is much to be said in their favor for all places where the load is comparatively constant, and in electric lighting they will become a source of economy if they can be adapted to the sudden changes in demand and can be worked with the same economy when firing for largely variant rates of combustion. To meet the controlling conditions some form of forced draft regulated by the steam pressure seems to be essential, so that the moment the pressure begins to fall the fire may be quickened automatically to meet the requirements. This has been done by attaching a pressure diaphram to the throttle of the blower engine.

"Smoke consumers," so called, are generally wasteful of fuel, but frequently they are demanded to meet the requirements of local laws. It is well to understand that there is no such thing as "burning smoke" but furnaces can be made to produce a minimum quantity. In this, however, as remarked of furnaces in general, one coal is not any criterion for another. A furnace which will burn a given coal without smoke will frequently be found to smoke badly when supplied by another coal. This whole question of smoke production is generally more a question of brains in the fireman than of construction of furnace.

Automatic apparatus for handling coal and ashes is generally a step in the way of economy in electric light stations as in other steam plants. But this is also controlled somewhat by locality, as for instance when, as at the Edison station in Milan, they pay but twenty cents a day for firemen, the addition of a few extra ones for handling coal and ashes does not add greatly to the running expenses.

Third. The boiler is perhaps the one thing which requires the most careful consideration in deciding upon an electric light plant. When we consider that in constant running a boiler, to speak figuratively, eats its head off every three or four months, it is plain that a reasonable additional cost for an economical boiler is a first-rate business investment. In other words a boiler which would save 10 per cent. of the coal would pay 30 to 40 per cent on its cost annually and would be

cheap at a round price as against another as a gift. But how may we know what boiler is most economical, when every boiler maker swears, with or without reason, that his is the one? Usually, in fact, the one with the least foundation makes the loudest claims, even going sometimes to the extent of bombastic challenges and offered bets, on the principle, probably, that that will enable him to rank among the better class. Preposterous claims are freely indulged in by the ignorant. I knew a case some years ago where a maker of a new boiler offered to guarantee under heavy forfeiture that he would evaporate nineteen and a quarter pounds of water to one pound of coal. And within two months I have seen a letter stating that a certain boiler, having no single element of economy, would double the work in the same time, and with the same coal, that another boiler, which is known to give 75 to 80 per cent. of the theoretical efficiency of the fuel, could do.

Unfortunately, buyers are not all scientists, and too frequently the biggest story, however preposterous and unsupported, if unblushingly made, is permitted to weigh more than real merit. But as I asked above, how are we to judge and decide this question? Here are some general rules:

(a) Set down all claims to the evaporation of over twelve pounds water per pound of combustible (unless it be oil, gas or hydrogen) under any conditions as made ignorantly or with an intention to deceive, and avoid such boilers as are claimed to do this, as either humbugs or soda water factories. (b) See if the boiler has the elements which are necessary to economy, such as a rapid and thorough circulation of water, thin heating surfaces, a well distributed flow of the hot gases, of sufficient duration to secure thorough absorption of the heat, and ample disengaging surface to permit the steam to be drawn off free from entrained water.

In this matter of circulation of water a caution needs to be given, also, as against many unfounded ideas and claims. To secure an effective circulation of water the currents must not only be separated from each other, but they must combine to form a continuous circuit (without interfering eddies or material enlargements), until the steam is ready to be separated from the water. Thus a series of horizontal or slightly inclined tubes open only at one end have many interfering currents and but a very slight circulation. Return bends connecting two or more inclined tubes cause such a collision of currents going in opposite directions as to effectually destroy the circulation, and when tubes open into an uptake wide enough to admit a downward current within it, the most efficient factor of circulation is taken away.

(c) Observe the record of the boiler for a term of years. Single tests may be made to show superior results with a boiler which is anything but desirable for actual use. Tests made in regular work are best, if disinterestedly made by competent engineers, but even here one needs to be on guard, as not infrequently tests purposely distorted are put forth as correct. A case in point: Near Manchester, Eng., a firm having put in a water-tube boiler, employed a well-known engineer of a boiler insurance society to test it. He made out that it was evaporating only about six pounds water per pound of coal—less than the ordinary Lancashire boilers. Suspecting that the test was colored by the well known antipathy of all boiler insurance companies to any boiler claiming to be safe, on the ground that people may therefore not desire to have it insured, Prof. Kennedy of London, the best known expert in the kingdom, was employed to make a test of the same boiler, and though it was, as he states, handicapped by the working conditions, he obtained under actual conditions of practice ten pounds evaporation per pound of coal.

But it is not necessary to enlarge further on this point, it being admitted that in wisely choosing a boiler, the heaviest claims for economy are not necessarily to have the most weight. There is here as elsewhere in the problem ample room for a coefficient employed by the late Hamilton E. Towle. At one time he read a paper before the Institution of Civil Engineers in England and in all his calculations as placed upon the blackboard there appeared a peculiar and unexplained quantitative character. When he was through one of the members rose to inquire the meaning of that mathematical sign, which was quite new to them. "That, gentlemen," answered Mr. Towle, "represents the coefficient of common sense, which we find necessary to employ in all such calculations."

But in considering the choice of a boiler for electric lighting purposes economy of evaporation is not the only necessary element. There are three others of as great importance, if not greater. One of these is the ability to be forced for a short time while the maximum load is on. This is very important, otherwise it is necessary to put in a plant large enough for the maximum and run it at great disadvantage except for the two or three hours a day when the demand is at the greatest. But if the boiler, while adapted to the economical generation of the average amount of steam required, can be forced readily to meet the greatest demand, even if it should be at a reduced economy for the time being, the average economy will be better and the interest account will also be less.

Another point of importance is safety from explosions. An electric light plant, as a rule, must be erected in the center of thickly populated communities, and therefore it is more important, possibly, to secure safety from explosions in them than in most other steam plants. Now, while a common boiler may not be liable to explode under good care, yet one of the most difficult things to secure under all conditions is this good care. Even the best of men become careless or forgetful at times, and hence good boilers sometimes explode when least expected. It is far better economy, even at a greater cost, to put in a boiler safe from destructive explosions, than to run the risk of a blow-up, with loss of time and capital, not to mention human life. Instance the Edison company at Chester, Pa., where the explosion of a new and well made return tubular boiler killed seven and wounded eight persons, besides demolishing the building. Even at a much higher first cost a safe boiler would have been good economy. But it is necessary in this matter also to employ a coefficient of common sense because so many claim safety for their constructions when they violate every element of security from explosion. As a rule a water-tube boiler properly constructed should be a safety boiler, but the mere presence of water tubes may be no surety whatever. For instance a boiler with a large shell bored full of holes like perforated card-board and strained almost to burning by reason of water-tubes being expanded into these holes—an exceedingly unsafe construction—is advertised as "Safety Boiler." Perhaps if the law in this country made the boiler maker criminally responsible for accidents in such cases, as it does in France, there would be fewer such reckless statements. In applying the coefficient of common sense to this problem of safety, one needs to remember that a large shell exposed to the direct action of the fire and all flat surfaces, stayed or unstayed, are elements of danger, and that this danger is greatly augmented by insufficient circulation of water whereby unequal expansions are permitted to occur with consequent straining of the metal.

The third important question to consider in selecting a boiler for economy is its liability to repairs. A boiler which is under frequent repairs is dear at any price, and one in which repairs are not quickly and cheaply made, is in the same category. This point is best determined by a long and extensive experience. Nothing else can decide it with any certainty. While tubular boilers may last for years in favorable circumstances, their *average* life is usually stated to be not over ten or twelve years, and their average repairs are usually estimated at 10 per cent. per annum on their cost.

Many go years without repairs, and I do not vouch for this estimate, only giving it as one accepted in ordinary calculations. As for water-tube boilers, the makers of the best known example publish the results of experience with an aggregate 100,000 horse power which have run from 2 to 20 years and on which the average repairs to the boiler proper had been but about one-half one per cent. per annum. They claim, moreover, and it cannot be successfully disputed, that in over twenty year's experience not a single boiler of that kind has been worn out in use, and that of all which have ever been sold in twenty-three years not less than ninety-eight per cent. are in use to-day. It is unfortunate, however, that the same cannot be said of water tube boilers in general.

Last, but not least, we come to the element of brains. No matter how good or cheap the fuel, how perfect the furnace, or how exceptional the boiler, unless brains are placed in charge the preparation goes for naught. It is not difficult to find a difference of twenty-five and even more per cent. in economy between the extremes of fireman with the same plant, to say nothing of repairs and stoppages caused by a little carelessness. It pays to have men of brains as well as brawn and muscle, even for firing fuel and watching water.

We have thus hastily considered the necessary conditions of economy in generating steam for electric lighting plants. Let us review them as a whole.

First. The use of the fuel which gives the best results for the least money. This varies with the locality.

Second. A furnace which will burn the said fuel to the best advantage, and at the same time permit of the rate of combustion to be quickly changed to meet the greatly varying demands without serious loss of economy between the highest and the lowest.

Third. A boiler which will utilize the heat to best advantage; which will give dry steam; which will permit of being forced much above its average rating for short times, without serious loss of economy; which is safe against destructive explosions, and which is not liable to frequent, difficult or costly repairs.

Fourth. Foreman and firemen with brains enough to employ all these things to the best advantage, and keep the apparatus at a point of maximum efficiency.

In selecting these elements of an economical plant it is urged that the co-efficient of common sense should be fully employed, and that facts gained from long experience are a far safer reliance than mere assertions not backed by years of practical results.

APPENDIX.

The following items, having more or less reference to the subject matter of this paper, will, I think, be found of interest by the members of the association.

Imperial Continental Gas Association, Vienna This plant, which has been at work since August, 1887, is very complete and efficient. Its principal work is lighting the Opera House and Hofburg Theater, which contains the equivalent of nearly 15,000 incandescent lamps of 16 candle power each. At the station there are 8 Babcock & Wilcox water-tub boilers, each having a heating surface of 131 square metres, which are fired entirely with coke, and supplied with water from the Danube Canals which, however, is filtered and chemically purified before being fed into the boilers. Four Worthington pumps are so arranged that the water may be pumped direct into the boilers or first through an exhaust steam heater, all connections being in duplicate. The engines are Willan's direct-acting high-speed, 3 of 170 indicated horse power each, and 5 of about 130-horse power each, and 4 smaller ones. These engines run from 400 to 700 revolutions each, according to size. The engines are coupled direct to dynamos of the vertical double magnet type made by Crompton & Co., the 3 larger ones giving 250 amperes at 400 volts and the 5 smaller ones 130 amperes at 450 volts. The small engines running at 700 revolutions per minute, give 150 amperes each at 50 volts and are only used for exciting the magnets of the larger machine. The engine room is fitted with 8-ton overhead traveler to facilitate repairs, etc. In the central station is also a workshop supplied with lathes, winding head and other tools necessary for effecting all repairs, as also a laboratory photometer room and the necessary offices of the building. In the cellars of each of the buildings lighted are placed large batteries of accumulators having 100 tons of plates in each, which are charged during the day from the central station. At night and during the performance the current from both the machines and the accumulators is used, the latter serving both for storage and regulating purposes. An elaborate test of this plant was made by Inspector Ehrendorfer and T. W. Mehlnish, A. M. I. C. E., a graphic representation of some of the results of which is hereafter given. The following is a summary of economical results obtained, the coke and the chimney gases having been carefully analyzed to determine the available heat in the coke and the amount carried off in the chimney.

The theoretical evaporation with one pound of coke of water from 32° to steam 212°, in pounds	11.½.
Of which there are used for generation of steam	79.21 per ct.
There was lost in the chimney gases	15 47 " "
Waste of coke in ash pits	.88 " "
By conduction and radiation	4.44 " "
Total	100 per ct.

77.59 per cent. of the indicated horse power was delivered in electrical horse power. The consumption of feed water per electric horse power per hour was 38.05 lbs. The consumption of coke per electric horse power per hour 3.78 lbs.

The largest proposed electric lighting plant in the world is that of the London Electric Supply Corporation at Deptford. The buildings now erected are intended to contain when finished 80,000 horse power of boilers with the corresponding engines and dynamos. At the present time there are erected 24 Babcock & Wilcox boilers of 250 horse power each, 2 compound Corliss engines of 1,500 horse power each. There are now being erected 4 engines of similar design of 10,000 horse power each; that is to say, these engines are double, one-half of which are at first to be erected, to work at 5,000 horse power; afterward a second engine to be coupled to the same shaft, making them full 10,000 horse power each. Each engine is to drive directly a single dynamo sufficiently large to employ its entire power. The smaller engines, 1,500 horse power each, are to give off 1,250 electric horse power, after deducting loss in mains, switches, flues, etc., and the 10,000 horse power engines with their single dynamo are to give off 10,000 electric horse power each. The exhaust from the engines will be connected into one main, with separate condensers worked by independent engines. The dynamos are constructed for the alternating current. The exciters are driven by triple expansion engines running at 280 revolutions. The feed water for the boilers is taken from the hot well and pumped through economizers, of which there is one in connection with each battery of 6 boilers. Steam pipes are of copper throughout; feed pipes partly wrought iron and partly of copper. The pressure of steam carried, 200 pounds to the square inch; all exhaust, not only from the main engines but from the feed pumps and blower engines, is carried into the condensers. The plans for this station contemplate its enlargement at a future day, when it is expected to contain 120,000 horse power of boilers and engines. It is to be worked on what is known as the Ferranti system with 10,000 voltage.

The same company has another station at the Grosvenor Gallery, which has been running for some years. It contains 4 Babcock & Wilcox boilers of 164 horse power each, carrying 140 pounds pressure, which are worked continuously day and night to upward of 1,000 horse power. The engine room contains one Corliss engine of Hargreaves' make, 4 foot diameter, of cylinder, running at a piston speed of 780 feet and coupled by ropes to a Ferranti dynamo, with a capacity of 15,000 8 candle power lamps. Three other horizontal, high-pressure engines with ordinary slide valve expansion cut-off gear, are connected to a counter-shaft from which another dynamo of smaller capacity is driven. Another engine and dynamo is kept in reserve for lighting the Grosvenor Gallery or to act as an exciter to either of the above dynamos. The exciters of the large dynamos are attached to an armature shaft and form really part of the machine itself.

The next most important electric lighting company in London is the Metropolitan Electric Supply corporation, limited, who have at present four stations, of two of which data are given: Sardinia street Station.—This contains 4 Westinghouse engines of 250 horse power each driving by belts alternate current dynamos, and 2 smaller Westinghouse engines, of 50 horse power, driving exciters by means of belts. There are 5 Babcock & Wilcox boilers of 250 horse power each, carrying 150 lbs. pressure per square inch. Rathbone Place Station.—Five boilers of 160 horse power each, carrying 200 lbs. pressure per square inch, and 6 Willan's triple expansion engines, coupled directly to Elwell Parker dynamos, giving 1 000 volts and 100 amperes at a speed of 355 revolutions per minute; number of alternations 12,000 at this speed. Two smaller similar engines are coupled direct to continuous current Elwell-Parker dynamos, giving 150 volts and 180 amperes—used for exciters. All the connections, both steam and water, are made on the multiple arc principle.

The Kensington & Knightsbridge Electric Ligth company have two stations, one at High street, Kensington,

and the other at Chapel place, Knightsbridge. In the former are 2 Babcock & Wilcox boilers giving 500 horse power indicated, and two high pressure compound Willan's engines directly coupled to Crompton dynamos. This station is soon to be increased to about 2,000 indicated horse power. In the Knightsbridge Station there are 2 Babcock & Wilcox boilers giving 700 indicated horse power, the engines and dynamos being substantially the same, which is also to be increased to about 1,900 indicated horse power. In the two stations there are, therefore, after making allowance for spares, about 1,900 kilo-watts available, or the equal of 57,000 10-candle power lamps lighted simultaneously. As, in the Crompton system, accumulators are employed as a means of distribution and reserve, these stations will be equal to the supply of 75,000 lamps burning simultaneously, and according to London practice 150,000 lamps can be rented out.

The cost of producing a unit has steadily decreased in this station until it is claimed that the coat for fuel, oil, water and all wages and material used for working the station and other general repairs, being divided out to the number of units sold to consumers during the month, amount to only 1⅛d (2¼) per Metropolitan unit. Crompton & Co. would be very much interested to know whether in America or any other country where the work is being carried out on an equal scale, any economic efficiency approaching this has been obtained.

Discussion.

F. E. Sickles: I would say in regard to Mr. Babcock's paper on boilers which has just been read, that I agree with it in the main; but I object to one statement, which I think it is right I should mention, and that is the statement that stayed surfaces are unsafe. We have tried long enough to know whether stayed boilers are unsafe; and we have had for fifty years in the world thousands of locomotives with a large amount of stayed surface running into stations every minute, and not one of all these has ever failed. It is not true that stayed surfaces are unsafe. They may be made unsafe, but they are not necessarily unsafe. But the general scope of the statement I think I can agree with. The idea that you must put a very rapid current through a tube and subject it to the passage of the heated gases at right angles to this tube, is correct. All experience shows that the best results have been obtained by placing the tube in that position where the current will pass rapidly through it with the heated gases impinging against it at right angles. But of course common sense when we come to reflect, will tell us some things. This tube must be made so as to carry high steam, and be reasonably small, so that we can get a large amount of surface in a small space. And it only comes then to the question of what is the best way to get that general result. I do not think it would be proper for me to mention any particular form of boiler that would be likely to come into use in an electric light plant. But I will mention one plan that will never come into use in an electrical plant, which illustrates, however, the value of very rapid circulation, with the gases impinging upon it at right angles and that is the Herischoff boiler. That is an apparatus of enormous ability for the surface and gets a very wonderful result, of course, at disadvantages that would be utterly impracticable in an electric light plant.

I believe, so far as being able to force a boiler is concerned, I think Mr. Babcock's statements are correct. It is important to so arrange the boiler that it can be forced in an emergency, and not be obliged to carry a large number of boilers that would be available, perhaps, only an hour in twenty-four. It is better to sacrifice a little economy rather than have too large an amount of money lying idle, as would be the case in having too large an amount of boiler surface.

T. Carpenter Smith: I think that the question of boiler surface in a station is one of the most important we have to deal with; and I think that there are two or three points about central station work that should be taken into consideration, in discussing the form of boiler to be used. With regard to the question of being able to force your boilers, that proposition has another side to it, beyond that of the mere question of having money lying idle. There are very few central stations doing incandescent work, in which the bulk of the load does not come within two or three hours in the day, and the load at that time will be enormously in excess of the average load. If you can force your boilers during these two or three hours, by keeping the fires clean, and being ready for the heavy load when it comes, you not only save the cost of a surplus boiler plant, but you save very largely in your fuel consumption. I know of a station where the fuel consumption is increased 50 per cent. by the necessity of having to fire up the second boiler for the two or three heavy hours' duty between four and eight o'clock. The banking of your fires during the day must be done or you have either to make a fresh fire. A banked fire takes a good deal more coal than would be sufficient to run that heavy load, than if you were able to force your boiler a little more. For that reason I think that a larger source of economy will be found in central stations, putting in a forced draft apparatus, than in increasing the boiler capacity. I know there is strong prejudice against forcing boilers on the score of danger, but I do not think that any electric light station should be run by any man that cannot be trusted to force a boiler without endangering it. I do not mean to force a boiler, of course, beyond a reasonable degree. With regard to the remarks on flat stayed surface, I have only one thing to say. I was brought up on big shell boilers, boilers of anywhere from six to seven feet in diameter, with one or two big flues through them; and there are several points in favor of such boilers, that ought not to be overlooked, such as easy cleaning and examination. Now it seems to me that when we once leave the large shell and come down to the use of tubes, we might as well throw out the whole thing, and get rid of every objectionable feature in a boiler that we can. Now it is true that flat stayed surfaces have been used for many years. It is true that the majority of the locomotives in the world, are using flat stayed surfaces in their firebox; but I think that ever since the flat stayed surface was put on locomotive boilers, there has been a constant desire to get rid of it if possible. It can be made safe, but it is always liable to deterioration, and to become unsafe. I do not know anything that is easier to get in a bad condition than a flat stayed surface. Therefore, I think if we can get rid of it, it ought to be done. If there should be two boilers, one of them which has the flat stayed surface, and the other of substantially the same construction and principle, which is without it, I would always use the latter.

Mr. Sickles: One element of safety in the flat stayed surface is this, that where you are carrying a regular pressure of steam, it yields very gradually, and it will give you notice weeks or months ahead that it is going to give out. Hence there is a certain measure of security in the flat stayed surface. It yields slightly; you can see the boilers running with a flat stayed surface, with a notice, you might say, painted upon them. They will still run for a while but of course there will come a time when the stayed surface will give out. But the practical fact is there are hundreds and thousands of locomotives with flat stayed surface, that have been running for half a century, and have not given out.

T. Carpenter Smith: I would like to ask Mr. Sickles, whether he has any figures showing the cost of keeping up these flat stayed surfaces in locomotives. I have been employed for a short time in locomotive shops, and I know that when engines come off the road the flat stayed surface always have to be tinkered with.

Mr. Sickles: I can say that every part of the locomotive boiler deteriorates very rapidly and the gentleman will find if he will look over his memoranda, that he tinkered as much with the tube as he has done with the flat stayed surface.

C. J. Field of Brooklyn, N. Y.: I do not think we ought to pass over Mr. Woodbury's paper submitted yesterday, without looking at it a little more carefully. We all know what Mr. Woodbury has done in New England mill construction, which in the last few years has done more to bring up the standard of buildings of that class and make them safer against fire, than any other class of construction in the country, And when we see that these principles can be applied to small station construction, I think these points are such as the electric light company ought to know and give attention to.

M. D. Law of Philadelphia: In the management of electric light stations there is one point that has not been specified by Mr. Woodbury which is very important as regards safety against fire. I have discovered the same trouble in Kansas City in the plants that are located here, especially in some of the private installations, and that is the packing of waste underneath the machine for the absorption of oil. It perhaps looks to you like a little matter, but in nearly every case, especially where high tension currents are employed, you have to use a wooden floor for the measure of safety. By packing waste under the machine you place a tinder box there. It may run for years without any trouble whatever, but in the case of an armature's burning out, and armatures will burn out, and throw fire for a long distance, this ignites at once, and you have a nice little fire to take care of. I speak of this because I had the same trouble several years ago in packing waste under a machine; an armature burned out and dropped some melted copper on the waste. The consequence was that all four field magnets had to be re-wound on the outside and we came very near having a nice fire in our station. It was only by having water buckets in close proximity to the machine and rubber blankets we were saved. The rubber blankets I think did more toward putting out that fire than the water buckets. They were immediately thrown over the fire and smothered it. Mr. Woodbury has given us an explanation of a baby station. It is of hardly sufficient size for even a country town. In our experience it is far better to build a two-story station having your dynamos on the upper floor in order that there shall be no posts or wires projecting up from dynamos to interfere with the rapid moving of machines from one portion of the room to another, or the changing of armatures. As the continuity of your lights is the criterion of your success, you want to have your machines in such shape that an armature can be rapidly changed, and also that if the machine flashes that the dynamo man can get there quickly, and that that machine may not flash the second time. Flashes mean rebates, and they are very expensive.

S. E. Barton: In reply to Mr. Law I think the reason why Mr. Woodbury has not referred to waste and things of that sort, is because he thought that was beyond the scope or intention of his paper. His purpose was to describe the method of the true construction of the station, and not the methods to be employed in the care of the station afterward, The question as to the danger of waste is purely a question of care, and gross carelessness or negligence may occur in the most modern and best constructed station as well as in the most poorly constructed one. I agree with Mr. Law that the cleanliness of the station is a very vital thing. In fact, I go farther, and say it is the most vital thing as affecting the fire risk of the generating station to-day. I believe that more than three-fourths of the fires that have occurred in stations have been due to carelessness, to want of cleanliness, and little bits of carelessness in the same line as those of which Mr. Law has spoken, from spontaneous combustion, and other causes. I believe further that a thing that is very sadly overlooked in the care of central stations is the condition of oil aside from the waste itself. A large amount of oil is allowed to accumulate on the station floors about engines and dynamos, so that when once a fire occurs from any cause whatever the material of the most inflammable nature is there to spread the fire in a perfect flash from one end of the station to the other. The air and floor are filled with volatile inflammable substances from the oil. I believe it is just as easy to keep the floor of a generating station as clean as a kitchen floor. I believe the floors should be made of hardwood and should be kept free from oil by washing at least once a week, or twice a week, if necessary. We have any quantity of stations in that condition to-day, where you could scarcely soil a cambric handkerchief on the floor except from the coal that is tracked in.

As far as oil is concerned they are absolutely free, and there is no danger of fire in such stations. If a fire starts it cannot make any headway. When a station is constructed as Mr. Woodbury designs, it would burn slowly. The keeping of a station clean by washing the floors in some instances cannot be well and safely done with the present practice that prevail, almost universally of running wires from dynamos down through the floor, for no purpose that I can conceive of except for the purpose of bringing them up from the floor again. I know of no reason why wires cannot go direct from the dynamo overhead in plain sight.

Mr. Sickles: The Cunard line of steamers ran for thirty years without having a fire, but they always had the hose stretched on the deck. That was the thing to do. The great thing to do is to have your hose ready for the fire, and if it is ready you will not have much of a fire. If you make preparations for fire and sustain them, and if the superintendent will strike the alarm once in a while, and see how quickly it is responded to, you will have no fire in the station.

J. A. Seely: I would like to know if there is any objection to concrete and what has been the previous experience in that line.

M. J. Francisco of Rutland, Vt.: If the gentleman will build a concrete floor and put his dynamo on it, and then try to handle the floor, he will get an illustration of what it is. In regard to Mr. Sickles' remark about the hose, it is the old saying that an ounce of prevention is worth a pound of cure. My idea is to put the station in such a condition that there will be no occasion for fires, and then you will not have to have any hose.

Mr. Torrey: Almost everything that has been said on all these three papers, came from men who are in charge of large plants or owners of large plants in cities, where if a good plant is not set up in the present light of mechanical engineering, there is some fault somewhere. I have spent most of my time for the last five years among the plants of our country brethren, where they do not have the facilities that you have in the cities. The problem there I claim is totally different. I have never heard in any electric light association, or read on the subject anything that would throw any light on the construction of stations in the country. Of course a little station of 25 lights is a small thing, but it is going to grow, and a great deal of the support of electric lighting is going to come from the country. The boiler question is an absolutely different question if you have a city with a good soft water supply that comes in hydrants, and where you can have the water brought into the building, from what it is in places where the year round there is nothing to depend upon but an intermittent supply of water that is hardly fit for use in boilers. I saw a station the other day of about the size that has been spoken of, where the load runs up to perhaps 500 incandescents during one part of the evening. Along after 12 o'clock the engine runs with a maximum load according to the indicator, of about 27⅜-horse power, of which 18.5-horse power is friction load. In the early part of the evening when the whole load is on, the load piles up to as high as 80 or 90 horse power. Where is the economy in that? It is unnecessary to say to any man who knows anything about electric lighting, that the station has never paid a cent, and it is still more obvious that it never will pay a cent under those circumstances. I remember another station that I visited last summer, where I was requested to overhaul the engine. It was one of the very best engines, and the only trouble with it was that when it got out of order, they gave the job of repairing it to any tramp that came along. After about three tramps had worked on it, the engine was in such a condition that no mechanical engineer in creation, unless he took a whole machine shop with him, could put it in good condition. I tried for three days to set the valves, and the engine ran well for about an hour, and when I came back the next day it was in just as bad a condition as ever. No man in creation could put it in good order and make it stay. The mechanical part of electrical construction is substantially all of it. I will venture the assertion, and I can back it up by any amount of figures from my experience that the majority of country stations do not pay, and the reason is because of the fault in mechanical engineers.

C. J. Field of Brooklyn, read the following paper:

Development of Generating Stations for Incandescent Light and Power.

BY C. J. FIELD OF NEW YORK.

I desire to present to you a brief review of the present and prospective future of central power plants in the larger cities, taking as an illustration one of the more recent types, describing its general arrangement, then proceeding to the consideration of its initial cost, earning capacity, output, operating expenses and economy, and in conclusion, trying to indicate the immediate future development in this class of work.

The immediate points to be considered and carefully weighed in the designing of a central power plant for a large city are many, and they should receive careful survey before any work is proceeded with. We will briefly summarize them as follows:

First. Recognition of the importance of safety and reliability in operation.

Second. Obtaining the true economy of output under all conditions.

Third. Installing of plant in a building entirely suited to the working of same, and as far as human ingenuity can provide proof against destruction.

Fourth. Adaptability to proper and economical working of the plant.

Fifth. Division of the generating power into the proper

number of units for the safe and reliable operation of the plant.

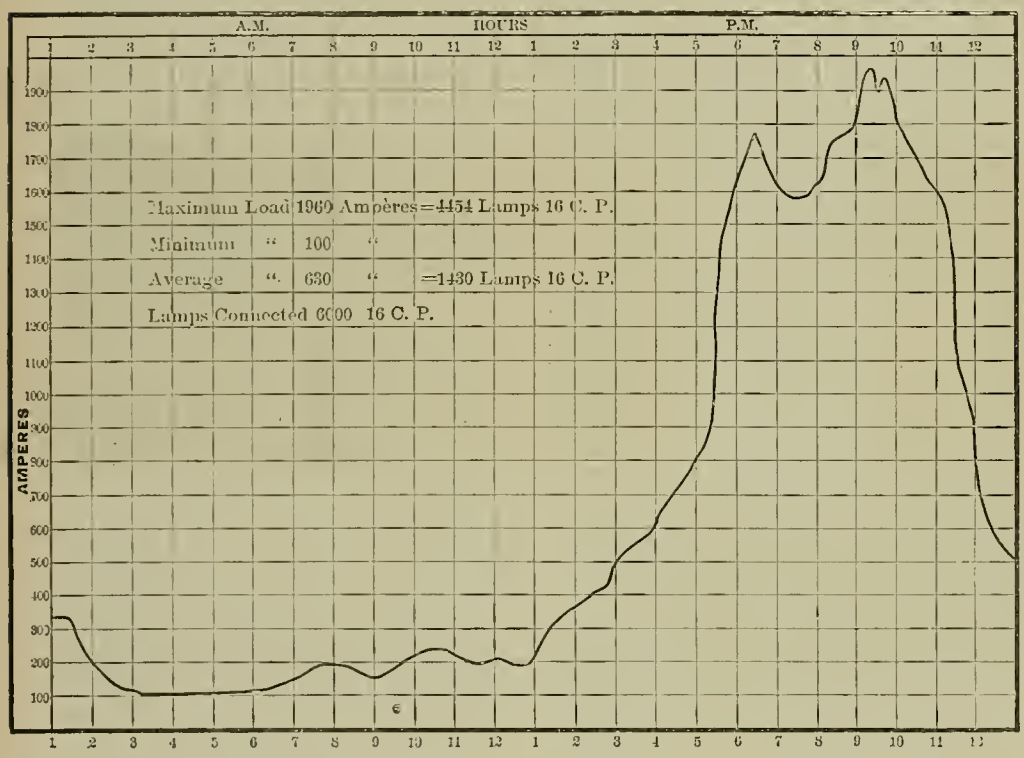
Sixth. Flexibility of system, that is, adaptation to furnishing current for light, power and other sources of revenue, the obtaining of the largest return per dollar invested, and not carrying to excess for the mere sake of engineering, by any part of the plant for the obtaining of proper results therefrom.

Seventh. Not installing the plant for mushroom growth, but laying it out for comprehensive business, thereby securing, at as early a date as possible, the entire confidence of the invested capital.

A true and careful consideration of these points will prevent trouble later on. Much of the trouble of stations at the present time, in their standing with the community, is due to neglect of this point, and the majority of their failures as well. We have got to recognize the fact that the public, to a certain extent, have become prejudiced, in a measure, somewhat unjustly, but this is all the more reason for better and more conservative management, and giving them good construction. No more inviting field is offered for either investing capital or good engineering than central stations for lighting, power and railway work.

I propose to take as a representative type, showing the present development and first-class work, the station of the Edison Electric Illuminating company of Brooklyn, which was completed last fall and is now in successful operation. With the aid of illustrations which are included here, I will give a general outline of the arrangement of this plant and apparatus used.

In the arrangement of this plant there was somewhat of a departure from previous general practice in this line, the company trying to secure the benefit of past experience in the larger stations of this class, both in the arrangement and kind of apparatus used, trying to secure at as economical a cost as possible, the best plant for the purpose.



DEVELOPMENT OF GENERATING STATIONS FOR INCANDESCENT LIGHT AND POWER.—LOAD DIAGRAM.

The boilers and engines are located on the first floor, the engines being on the front half and the boilers at the rear, thereby bringing everything on this part directly under the eye of the chief engineer, making it much better than where the boilers are located two or three stories up; this was obtained by spreading out a little more on the ground. The boilers are Babcock & Wilcox's largest type of sectional water tube boilers. The engines are 300-horse power, compound, horizontal, automatic engines, manufactured by the Ball Engine company. Each engine is directly belted to two generators.

Ascending to the second floor, we reach the electrical part of the plant. Here are located in the front part of the building, directly over the engine room, 24 dynamos, each with a capacity of 750 amperes and 140 volts. Each dynamo weighs about eight tons. Overhead traveling cranes are installed here and in the engine room for ready and quick handling of all apparatus. Through the center of the dynamo room is located the electrical gallery. From here are controlled the workings of all the dynamos and other apparatus, also all outside lines, everything in connection with handling, generation and furnishing of current, is directly under the eye of one man in this gallery, and from which he has a general view of the dynamo room floor and the workings of the dynamo, a second man being on the floor to see to the bearings and brushes. From this gallery run all the feeders, which connect into the net work of mains covering over an area of about one and one half miles square. The ampere meters are located on each feeder, so as to show the load in each part of the district. This plant maintains its distribution and regulation thereof by balancing within itself. No feeder equalizers are here used for feeder regulation; the uniting and tying up of the system together with the use of the auxiliary bus affects this regulation. All circuits of this plant are underground, there being about 25 miles of underground conductors. These have given perfect satisfaction and reliability in their workings, maintaining to-day an insulation on the system as a whole of over half a megohm.

On the rear of the second floor are located the coal storage, water tanks and feed water heater. On the top floor we have the offices, supply rooms and workshops of the company. Returning down-stairs again, we find in the basement ash pits, smoke flues, pump room, two large coal storage vaults, giving a total capacity for storage of over 1,000 tons, air blast for force draft, and other details in connection with the steam plant.

We have, therefore, here in a building 75 x 100 feet, apparatus and all departments complete for the generation and supply of current and power for a capacity of 40,000 lights, or the equivalent in light and power, and so arranged as to secure, as far as can be foreseen, continuous working of the plant and entire reliability in the furnishing of its current. It is only thus that we can hope to obtain a business and establish ourselves on the commercial basis which gas light companies have placed themselves in the past years, and thereby secure to our stockholders the returns for which they have invested their capital.

Having thus generally outlined this plant, we will now turn our attention to the consideration of other points in connection with it. One of the most important items is the cost of such a plant. I give you below, in round figures, the cost as shown by the construction accounts and estimates:

Station building, complete, including all fittings, foundations, stacks, furniture, etc.	$100,000
Real estate	36,000
Steam plant, including engines, boilers, pumps, heaters, piping, bells, etc.	50,000
Electrical plant, including dynamos and all electrical apparatus, as switches, etc	40,000
Underground system, material	115,000
Excavation and labor installing same	35,000
General, including lamps, meters, tools, instruments, engineering and architectural expenses, wiring, services and office furniture	50,000
Total	$426,000

This includes the entire cost for the plant as it stands today, which, as far as the building is concerned, is complete for the entire capacity. At present there is installed generating capacity of boilers, engines and dynamos, for one-third of the final output of the plant. The electrical apparatus is complete for the entire output, with a very few additions in the way of a few switches, etc. The underground lines have a capacity for 20,000 lights. The work necessary to complete the plant for its entire capacity would amount to about $200,000 additional.

For this amount there has been obtained here a plant, which is considered equal, if not superior, to any of this class, and at a cost of 20 to 30 per cent. less than is expended for similar ones.

I will take up the next consideration of the operating expenses of such a plant. In order to place the company on an earning basis we have to secure to start with a certain number of lights or an equivalent in lights and power to clear the necessary general and operating expenses, which will exist regardless of the smallness of the load; in other words, we must have for such a capacity plant not less than 5,000 lights with an average income of $8 per light per year to clear the general incidental and operating expenses. This figure we may consider as our unit of operating capacity. From this we can figure the increased earnings and profits for the larger number of lights connected. There exists practically a constant ratio of variable and fixed operating expenses. By variable expenses we mean those obtained on a variation in load and increase of business; this includes coal, oil, lamp renewals and small increase from time to time in the amount of labor employed. The fixed expenses include those items which remain practically constant under varying conditions of income. A careful analysis of all the items covered in these expenses in such a station as this one, gives the following result: That the fixed expenses are 75 per cent. of the whole, and the variable 25 per cent. approximately, or in language which may appeal more directly to you, if we double our income or business, we only increase our expenses 25 per cent. This shows that a station's possibilities and profit lie in increasing this business from the unit point.

The average income per light in stations of this class vary in different parts of the country and with different loads.

We have illustrated a load diagram taken from this station, which gives you a fair idea of the changes and variations here taking place. The maximum number of lights lighted at any time in proportion to the number connected is very good for such work, and shows a good class of business. The load diagram through the day, however, shows a new station on a clear day with a small number of lights lighted, and power work only just commencing. It is this power work that wants attention, and the securing of which means the bringing up of this average load during the daytime to a good paying basis. The curve for the evening hour indicates a good, broad, solid load, which shows the combination of six o'clock business with the addition of a good solid evening load. Many stations after reaching the maximum point around six o'clock, rapidly fall off and never regain this point again for the evening. Here we have the illustration of clubs, theaters, churches, concerts and residences, lighting after supper, bringing up the load to its maximum point between eight and nine o'clock. The average load for the twenty-four hours, which is about 25 per cent. of the maximum, is a very fair one, and with the addition of the day load that will come on with the addition of power, will make this a model load diagram. The general run of stations shows as an average for the twenty-four hours, from 20 to 40 per cent. of the maximum load; the latter figure is very seldom reached. The writer knows of one station in which we have the latter figure and where, if we eliminate one short half hour around six o'clock, we have the remarkable showing of 75 per cent. average load for the twenty-four hours.

I also wish to illustrate here some remarkably fine indicator cards, which show the workings of the engines of the steam plant in this station.

The division of work shown on the cylinders is as follows:

I. H. P. head end high pressure cylinder	$63\frac{4}{10}$ H. P.
" crank end " " "	$60\frac{2}{10}$ "
" " low " " "	$59\frac{2}{10}$ "
" head end " " "	$55\frac{1}{10}$ "
Making a total I. H. P.	$238\frac{4}{10}$ H. P.

with a boiler pressure of 110 pounds, revolutions 223 and load 1,200 amperes, which is the equivalent of 2,725 lamps, therefore giving for the indicated power furnished, eleven and one-half lamps per horse power. This is for power developed, making no allowance for friction of engine and dynamo. The friction of the engine is less than 5 per cent. of its normal capacity.

Having in the above given a general outline of this plant, its cost and operating expenses, I now wish to call your attention to the points in connection with the type of engines, boilers, dynamos, underground system, etc., to be adopted in a station of this class.

We will first consider the question of the engine. As already stated, in proposing the engine power of a station of this kind, we first have to consider the question of using either the Corliss or high speed engine. Regarding the use of Corliss engines in a plant of this kind, we are frank to state our objections. Excessive first cost, ponderous machinery, counter shafting, pulley, clutches, etc., lead us to believe that these things are unnecessary when the problem is carefully considered from an unbiased standpoint. What we are after is results, not theory, but actual practice. Assume, for the sake of argument, that we can save 5 or 10 per cent. in steam economy, if this is obtained at a cost, the interest of which amounts to more than this, we are obtaining it for no good whatever; furthermore, there are many other problems in electric light stations which we have to carefully consider in this question of steam plant, one of which has been enumerated before, the question of reliability in operation, and always being ready for service. One of the latest types of stations combining arc and incandescent, where we have the Corliss engine in all its perfection of detail and apparatus, is that of the Narragansett company in Providence. If one will carefully look over this plant, as I had the pleasure of doing a short time ago, with others, and consider all these problems carefully, and then examine a station similar to the Brooklyn one, I think he will be forced to admit this fact. We want to obtain our power as direct from the engine to the dynamo as possible, and at the same time as cheaply, and obtain the best economy under the variable loads that we are going to have. We cannot design our plant for that capacity which is reached as shown on our load diagram, for only a short time in the twenty-four hours, but we must so design it to give this result for the average that we have during the twenty-four hours. Even where we have a more constant load, as in exclusive arc lighting on municipal circuits, I think even here we need to carefully consider the problem as well.

High speed engines, so-called, although they are not in piston speed any higher than the Corliss, but merely in rotative speed, have shown a considerable development and marked advance in the past year, and the next year is going to see even more development in this line. Owing to better workmanship, better designing and building than formerly, the prejudice which largely existed among old engineers against this type of engine, is rapidly wearing away. With the single cylinder engine under variable load, we often obtain poor economy, but as compared with the Corliss, under similar conditions, allowing for the dis-

crepancy in price, the result is not so disparaging. Now they are going further, and building compound and even triple expansion engines of this class. In the Brooklyn station we have one of the representative types of this class of engines, being horizontal, compound engines, which we here illustrate to show their general design in more detail.

These engines are built for higher economy and economical work, and the guarantees made on them I think compare favorably with the guarantee on compound Corliss engines; at least three or four of the manufacturers of this class of engine stand ready to-day to guarantee from 22 to 25 pounds of water per indicated horse-power per hour. I do not know of any Corliss manufacturers who are willing to do any better. This is for non-condensing, condensing from 17 to 18 pounds of water per horse-power per hour. Engines of this class are as well built now in workmanship, and as reliable in operation as can possibly be desired. Added to this, we have the advantage of direct connection to our generators, avoiding all the intricacies of shafting, etc., and the unreliability they entail. Tests made at the Brooklyn station have shown that the engines have actually come up to the guarantee made on them, and that the plant there is showing, as compared with single cylinder engines, an economy of coal per unit of output from 25 to 30 per cent. better. In a station of this kind, the actual coal consumed per unit of output at the dynamos is considerably larger than is shown on a direct test where we charge the engine only with the coal it uses directly. The weekly records from stations of this class charge the horse-power output with all the coal used by the engine, pumps, condensers, well pumps, cleaning fires, blowing off boilers, etc., and where the former item is about three pounds of coal per horse power per hour, we have in the latter case, making no allowance for the engine running empty, a result 50 per cent. greater than this. Economy in this line, however, is not going to stop at compound engines, as there are being built by at least two manufacturers, triple expansion high speed engines. I have not been able as yet to obtain drawings of this engine but illustrate here a type of engines of this class, which has been imported from France by Thomas A. Edison.

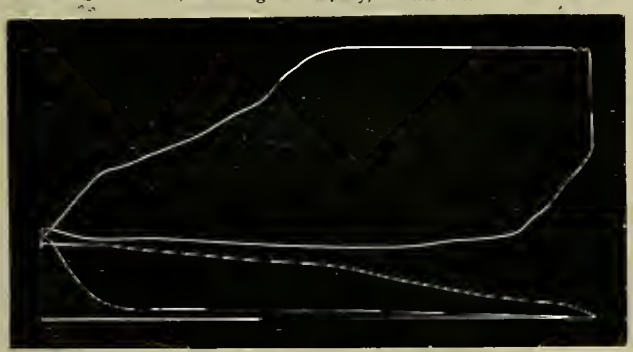
Something similar to this is what we may obtain to-day if encouragement is offered from such engine manufacturers as Armington & Sims, Ball Engine company, McIntosh & Seymour and others. We are coming to a recognition of the fact that if we want the high economy, we can obtain it as cheaply and as well, not to say more cheaply and better, with an engine of this class as with engines similar to those installed in the Providence station. In guaranteed economy, it will equal the Corliss engine as installed in the Narragansett station, and give it to you under a wider range, the load.

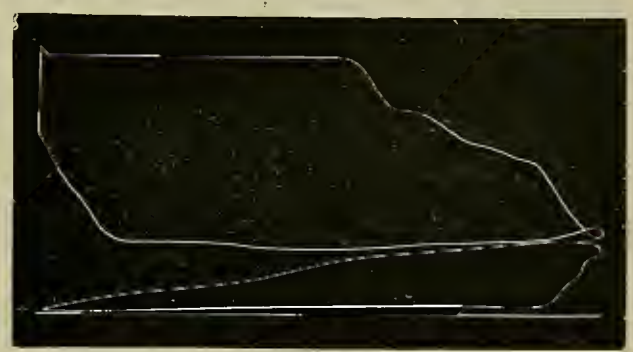
In connection with the triple expansion engines mentioned, we have to consider, again, the problem of the dynamos to be used. We can stay as at present, and belt to our dynamos, but I believe that the next large incandescent stations will not only include compound or triple expansion engines of 300 or 400 horse-power, but will also have multipolar dynamos, one or two being directly connected to the engine. By this I do not mean belted, but direct shaft connection through a flexible coupling. This, of course, necessitates the multi-polar machine, in order to secure the output with a slower speed. Engines and dynamos of this type can be installed in the space at present occupied by the engines alone. This means not only economy in building and real estate, but also in operating expenses.

In regard to boilers for such a plant, we do not know that we have any new economy to be hoped for in the near future. All we have to look for at present is improvement in detail of manufacture and the securing of better and drier steam. We have two classes of boilers prominently before us for this work. We have, in general, first, horizontal tubular boilers, which we find in general factory use, to a large extent, throughout the country. Where we have plenty and cheap real estate, poorer attendance and moderate steam pressure, this class in general fills the bill. We find, however, that they are now even building them to work up as high as 125 pounds' boiler pressure. When we come to construction of the boiler plant on expensive city property, where we are cramped for space, we are almost limited at once to some one of the types of sectional water tube boilers. In the Brooklyn station we are practically limited to the consideration of this class, and we have not only 125 pounds, but 150 pounds boiler pressure, and even higher. We have also the advantage of quick steaming under heavy changes in load.

We have, to-day, brought before us in the underground systems, the consideration of what is to most of the companies their most serious problem, to the proper solution of which the best talent is being devoted. In the Edison underground system we have what is generally recognized as the most practical solution for circuits of less than 400 to 500 volts. We here obtain at a minimum of cost the most flexible system and local distribution from house to house, which has no equal. It enables you to take off services for local distribution from every 20 feet without in any way affecting the insulation on the main line, and being able at any time to disconnect these services and restore the main to its original condition. In any other system we have the problem of splicing and cutting of cables, which at its best is bad work. What we desire is not such a high insulation, as good, mechanical protection As long as we can hold a moderate insulation with good, mechanical protection, that is all we want. In Paris they have used bare copper conductors, supported on porcelain in a concrete conduit. This has worked satisfactorily in the main, so far, but, of course, is very expensive. They are now proposing for all their increase, the Edison tubing for this class of work. In any system of cables drawn in we have the selection of a large class of conduits, but in my mind all we need and desire, as I have before stated, is mechanical protection for these cables, and the cheapest conduit that will afford this protection is all that is necessary. What is wanted especially is some system of local distribution for these higher tension circuits. The underground system installed in Brooklyn has a network of underground conductors in the mains and feeders of over twenty-five miles. This entire system is so arranged, distributed and connected in a net-work that, with a drop or resistance of 1 per cent. on the mains and 10 per cent. on the feeders, we are able to maintain in the system practically a perfect regulation in the distribution of the current. This system stands to-day representing one of the most complete and perfect examples of work of this class. The largest problems that we know of in underground work are the proposed new extension of the Edison company in New York, and the underground system of feeders proposed to be installed for the West End railway of Boston. The copper alone for the latter amounts to over $1,000,000; and this question of the cost of the copper calls my attention to a fact which I desire to notice, that much of this question of bugbear on copper is uncalled for when we are considering the underground system. The entire copper used on the system in Brooklyn is less than one-fifth of the cost of the underground system first installed.

I do not desire to claim that the ideas for the class of work here represented and described, hold or represent all the perfection to be obtained in central station work. There are many points contrary to the ideas here outlined.





DEVELOPMENT OF GENERATING STATIONS FOR INCANDESCENT LIGHT AND POWER.—INDICATOR CARDS.

which are very desirable; I have merely tried to call your attention to what I consider good work in this particular line, and hope that it will result in bringing forth the discussions and additions which are very beneficial in the consideration of these problems in the results to be obtained, and I would only add a tribute to the powerful and master mind whose work, from the commencement of this field of central station distribution, has covered the leading problems and points, and whose ideas to-day represent much of the good and very little of the bad problems which we have in this work. I refer to Thomas A. Edison, whose work, commencing in this field on the old Pearl street station in New York, over eight years ago, when the majority doubted, and but few believed in its successful carrying out, and while we find that station until within the past few months, when it was partially destroyed, successfully working, and even antiquated as it was, earning large dividends. He has still continued actively to impregnate his ideas in the work from that day to this, although he has not taken such an active part in its carrying out, but I think we may see him at no distant day, again taking a hand in this work, and bringing forth many new ideas in advancing the progress of the future.

Discussion.

A. J. DeCamp: I think in the early part of the paper the statement was made that the fixed expenses of the station were 75 per cent., and the variable expenses 25 per cent. May I ask just what was meant by "variable expenses?"

Mr. Field: Variable expenses are coal, lamp renewals, any increase in oil, and any addition to the labor account.

Mr. DeCamp: Do you not keep extra pay rolls?

Mr. Field: No, sir; if we double our output, of course our pay roll would increase to a certain extent.

Mr. DeCamp: My understanding of it was that your fixed expenses were 75 per cent., and the variable expenses 25 per cent.; and I inferred that was the actual fact. But there are what you term "variable expenses." Of course there is an average on which you made them up?

Mr. Field: These are based on 5,000 lights connected, and are based on natural facts. But the labor account for that number of lights connected, goes into the fixed expenses. There is no variable labor account or extra labor, or anything of that sort. We have 1 0 per cent. operating expenses, of which 75 per cent. is independent of the number of lights connected. If we double that number of lights connected, making it 10,000, our operating expenses will increase approximately 25 per cent. I recognize the fact that estimates will vary in different stations, and to a different extent, according to their management and the way of working the operating force, etc.; but it is about the figure in stations of that class.

A. J. DeCamp: In my judgment I see no reason at all why there is any occasion for any estimate as to what expenses are; the expenses of running stations are fixed facts; they are ever present with you. While you may control your income absolutely, you can't control your expenses; that is you have to accept them as they appear to you using due economy. But there are certain things that must be done. My own experience in arc stations is that they are very regular indeed, and any variation from a prior month's business can be noted at once without much trouble. I think that the theory of the ratio of the increase to expenses, is not properly appreciated. I believe the ratio of increase to the ratio of expense is very much greater than is generally supposed. I have had a little experience in that direction and I draw my conclusion from that and from considerable observation.

Mr. Field: I have not drawn these conclusions from one station, or from theory. They are drawn from facts as they are represented, and facts as represented in a large number of stations of the same class, based on actual results in them, in different lights, at different times in their history.

A. P. Seymour, of Syracuse: It seems to me, there is one rule that can be applied to all localities. That is the rule of using common sense which can be applied everywhere and under all conditions, to great advantage. Another rule that can be applied everywhere is to do your work well. If you can't afford to do it well, don't do it at all. If you start out under the rule that you must do your work well regardless of expense you are sure to get economy and good results in the end.

In our station we are using Corliss engines. We used to use high speed engines but we took them out and put in the Corliss engine and we have found that our saving is about 52 per cent. in fuel. Of course we are in favor of the Corliss engine. Our conditions of course are different than they would be in an incandescent station.

J. F. Munsie of Brooklyn, N. Y.: I desire to ask Mr. Field a question. You claim that the Edison is the best for distribution?

Mr. Field: I said for certain classes of work.

Mr. Munsie: Well, for electric lighting distribution?

Mr. Field: On lower tension circuits.

Mr. Munsie. Individual circuit distribution, we have on exhibition here, which I think will clear up that assertion, without any more talk on it and one which I think all the members of the association should examine.

A J. DeCamp: Now, I have often said that the business of electric lighting was either one of progression or retrogression; that is based upon my experience and observation. If you will watch a company that comes to a halt, and settles down to a certain point, you will observe it is retrograding. The pressure upon you for electric lights and power is such that you have got to go on progressing.

Mr. Field: When you come to make your estimate for the increase of capital to increase your plant, for your plant is capital, the question will arise, what are going to be the terms. If you base it on what I term, and I still think is largely theoretical, that the output of capital will give you an increased income at such an increased expense, that can be ascertained approximately. I think that there are a great many mistakes made in that direction. I do not think there is a single portion you can figure down in a single plant.

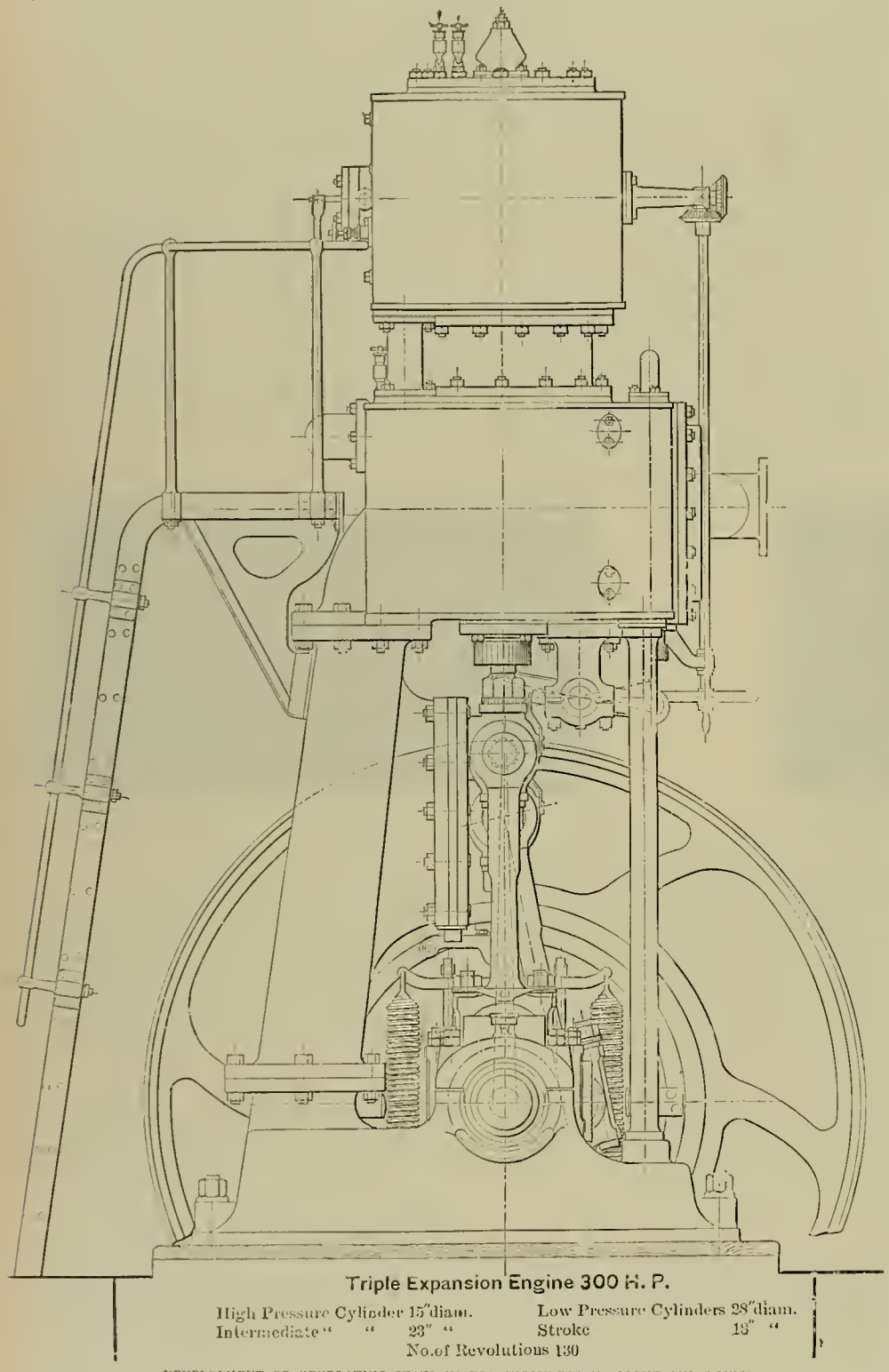
Mr. Armstrong; Let us assume that we were only earning enough to pay our expenses. I supposed by the expenditure of a little more of that which he has termed "variable expenses," that I could double my receipts, and that seems reasonable. I could double my revenue, by an increase of say 25 per cent. in my expenses; that was my understanding. If that is not so, then it seems to me, that electric lighting is rather a peculiar business. Of course I do not profess to know anything about electricity, or much about the mechanical part of it. The only thing I am particularly anxiously looking for is the dollars and cents; that is what I am in the electric lighting business for. I am not a scientist. I do not profess to understand anything about that, but it seems to me that this is going to be one of the great businesses in the future. This association represents one of the great businesses of the country, and therefore this point is something that we ought to have particularly cleared up. I am more pleased with this paper than anything I have heard here at the convention.

Mr. Field: Some gentleman brought up the point about increasing your plant, you have got to make an additional outlay; that outlay I have not considered at all in my papers. That outlay is going to vary under different conditions. If you increase your plant you of course get an additional income. I have assumed that increasing your outlay, your capital is going to increase proportion-

ately and that you will not add a debt on which you must pay interest. That question of that proportion will be found in the class of work which I have outlined for incandescent stations. I know stations which I could give by name where results are actualy obtained, where many of them have gone on the false idea that has been prevalent for many years, of working just on the border line. They had a good business, but did not have the capacity to increase their business, or lacked management. In these cases no increase of plant has been made but an increase of plant would have been followed by good results to the station and directors and stockholders. It is a proposition you have got to meet You must get to business. You cannot go on the border line. You must do the same as the gas companies and you will cut your operating expenses down to the small figure to which they have reduced theirs, compared to their income. It is only in that way that you will get the good re ult in your pay roll, in your labor account and all those points that I have tried to outline. They are all very largely dependent on your business, on your plant.

Mr. Alexander: I think Mr. DeCamp and Mr. Field are right in their respective ways. Mr. DeCamp's experience has been with arc lights where an increased business does involve a large increased cost for labor for repairing circuits, supplying carbons, etc., things that Mr. Field does not have in the incandescent lamps. The operating expenses need not be increased very much, or so much in the incandescent station. Mr. Fie d made one remark in his paper, that within five months they had but one cross which they blew out. I suppose he meant that they burned it out. I want to ask whether the third wire was grounded and secondly, whether he considered it safe to blow out a cross? I think if you do that you increase the danger of electric lighting considerably.

Mr. Field: The question of grounding the neutral wire on a three-wire system has not, I think, been thoroughly settled. But it is a thing that has to be left to the individual judgment of each manager. It varies in different systems You strike some old systems where they practically have not grounded their neutral wire owing to defects in their underground system. They have done that to avoid a cross between their two outside wires.



DEVELOPMENT OE GENERATING STATIONS FOR INCANDESCENT LIGHT AND POWER.

In answer to the question Mr. Alexander asked, about blowing off the ground, I think it is like this, when you get a heavy cross on your underground system, what are you going to do? You must shut down or blow it off. I do not think you are taking any great chances. I have seen a good many blown off, and I never knew them to give trouble. They will make the lights shake for a few minutes, and then you will go on serving your customers just as you did before, and take your time to hunt up the cross.

Mr. De Camp: I once sent $2.50 in response to a circular of a gentleman who advertised a perfect way to find mistakes in a trial balance sheet. I got his rule of which there were five or six columns, but there was a note following that wherein he said, "If this don't suffice, hunt for it."

T. Carpenter Smith of Philadelphia addressed the convention on the subject of Central Station accounts, etc.

A System of Station Accounts.

BY T. CARPENTER SMITH.

Having asked and been asked many times as to the cost of producing electric lights, and having received and given answers which varied widely, without having any means of reducing them all to a common denomination, I have thought that some system of doing work and keeping cost, might be devised which could be used in stations of any size, and at the same time enable us to make fair comparisons between them. To do this it means that we ought to have some general principles of doing work, and carrying on the routine duty of the station, which principles should not be burdensome to stations of small capacity, but the details of which could be elaborated as the station increases its business, until it should fairly result in a company being able by a simple inspection of its books to tell what it costs to do its work from day to day, and on just what items of its business it was making or losing money.

We all know that in the electric light business there are certain contracts which must be taken and which must be done, from which no real return can be expected, and the problem is to know just how much we make or lose on each particular contract, in order to decide quickly whether the "game is worth the candle" for such cases. To find what is necessary to be done in the highest development of this method, I think the easiest plan will be to describe a system organized some years ago, which has stood the test of time and service, with the need of but few changes.

I do not wish to be understood as claiming that this system presents any great originality, since the most of it is only the application of methods of carrying on business which have been worked out from time to time. The application of some of these methods, however, to electric light station work, is, I believe, new.

The first main principle is dividing the staff into two distinct branches: the station and the office. This may not seem practicable in small stations, but I would explain that this has reference simply to the official capacities of the men.

In small stations it is very likely that one man will be a sort of "Pooh Bah" who fills many offices, but the lines of duty must be kept clearly distinct from one another. Without doubt all companies have been more or less annoyed by the continuous waste of time and money from customers sending complaints to the station or having little odd jobs attended to for which they never think they should pay. For such service it would cost the company more to collect the money due then the whole affair is worth; at the same time one does not want to run the risk of offending an otherwise good customer by refusing to do an apparently trifling service.

By separating the office from the station, and having all complaints sent to the office, it simply makes it not quite so easy for the customer to demand anything of this kind, and any employe of the station who is doing work in a customer's establishment has for an answer to any request to do something outside of his regular duty, that he cannot do it without an order from the office, at the same time saying that no doubt that it will be all right if the customer will make proper application.

The office can very easily, when such inquiry is made, volunteer the suggestion that the work will cost but a trifle, not more than so many dollars and cents, which gives the customer at once to understand that he is expected to pay for it, and the customer who bargains is lost.

The office under the direction of the secretary or general manager, and their subordinates, makes all contracts, orders all supplies, and receives all complaints; in fact is the only communication of the company with the outside world.

The station under the superintendent, or chief engineer and his subordinates, does all work, and is responsible only to the office, and has nothing to do with any one outside of the company.

The second main principle is that no work is to be done, except on a definite order, and all supplies used, all men's time, and all expenses are to be charged to this number, without any reference to what kind of job it may be on. Duplicate books are kept in the office, and in the superintendent's office at the station, in which the orders as they are determined upon are entered in regular routine, and the men working upon them do not need to know in the least who is to pay for the work, or in whose name it is being done; but all orders, requisitions, bills, etc., are charged to order No. "X." Any man doing work, for which he has not a written authority, and a proper number to charge the same to, is not paid for the work, and thus men will very soon learn that this system will save an immense amount of time and trouble to themselves.

The third principle is that all supplies must be received, and issued by the store-room; whether it be a new engine or dynamo, or a sheet of crocus cloth, the store-room must have the proper orders and receipts for such issue.

These principles being established, and the station ready to start, let us see what the first operation would be. A new order book being opened, order No. 1 made out in the office of the company, would read: "Operate boiler room"; number 2, "operate engine room"; number 3, "operate arc apparatus"; number 4, "operate incandescent apparatus"; number 5, "operate power plant."

These orders would practically cover the running of the station, if it be desired to itemize as is shown above. Where it is not desired to separate the cost of each of the plant, the whole might be classed under one order,—"Operate the station."

A contract, say number 7, being made with a customer by the office, and the exact amount of work to be done by the company entered upon the form of the contract, the customer's signature is attached. A copy of the contract, detailing the amount of work and supplies to be furnished, is attached to a blank form, which is sent to the superintendent, and which is headed,—"General order No. 101," and might read,—"Wire up John Jones' store for 60 incandescent lamps, as per terms of contract number 7, hereto attached."

When arranging to make this contract, the office may have found that they have no pole line extending up the street on which this customer's store is located, and they will therefore have to make arrangements to build this pole line and run the wire up to reach him, at the same time they may find they have reached their limit of load on the various machines, in the station. As the building of this line would probably give them a number of other customers upon it, they decide that they will at once proceed with the placing of a new 150-horse power engine and dynamos for it, and they accordingly proceed to order the new engine and dynamo and make out two more orders, which might read: "General order number 102. Build pole line and string arc and incandescent circuit on Twenty-first street, corner of High," and "Order number 103: Set up new 150-horse power engine in engine-room, and connect it with the main steam pipe."

The other orders for setting up the dynamos and connecting to switch-board would follow in a like manner.

These forms signed by the secretary and general manager are the superintendent's authority for proceeding with the work, and he proceeds to fill out other forms which he delivers to the proper foremen. In this case these forms would read:

"Superintendent's office—To Mr. Blank, foreman incandescent wiremen:

"Do the following work: Wire up Mr. John Jones' store, etc., as per slip attached hereto. All labor, material used, to be entered up on this form. General Order No. 101."

This is placed upon the proper hook for the incandescent foreman, and constitutes his authority for all labor and supplies. The superintendent would then make out another order on the foreman of linemen, as follows:

"Mr. Blank, head lineman:

"Do the following work: Extend pole line, and run arc and incandescent wires up Twenty-first street to corner of High. All materials and labor to be entered up on this form. General Order No. 102."

Also a third order to the chief engineer:

"Mr. Blank, chief engineer—Set up new 150-horse power engine in engine-room, and make proper connections to steam line. General Order No. 103."

If it is desired that this last work should be done by contract, the superintendent, it will be observed, can make this order instead of to his own chief engineer, to any contractor whom he may desire to employ; but he would make his order read: "Set up new 150-horse power engine, etc., as per contract hereto attached," and would then have a regular contract drawn and attached to this form, which would still keep order number 103 as the one to which all expenses, etc., are to be charged.

Following out these three representative orders, we would say that each foreman carries a small "Foreman's order-book," with the leaves divided into two parts. Any order written on the first half of one of these leaves, for materials, will be honored at the store-room by whoever presents it, as long as it carries the foreman's signature, and the foreman for his own protection writes a duplicate order on the stub, which he keeps. These orders form the store-keeper's voucher for all material issued, and the foreman who issued the order becomes responsible for the material as soon as it has passed the counter of the store-room.

It is found very convenient to have these "Foremen's order-books" printed on different colored paper, for the different departments.

The fireman, engineers, dynamo tenders, trimmers, etc., in fact all who are employed on the regular routine work of the station, each receive a number of numbers from the foreman of their department, to which they charge their time from day to day, according to the hours spent on each separate item.

The book-keeper in the office, as soon as an order is entered in the order-book, and the proper orders sent to the superintendent to have it carried out, opens an account on his ledger with his order number, to which account are charged all material, supplies, etc., to be used, whether the company is to receive any money for the services or not.

When the foreman in charge of the work reports the order completed, the superintendent returns to the office the original order which he issued to the foreman, which has entered upon it all material, labor, etc., used; after taking a press copy in a letter book, which he retains as his record of the cost. The ledger account is then closed up, and the company knows precisely what this work has cost them. If they are to be paid for, it forms a basis of their bill; if they are not to be paid for, it lets them know how much money they have sunk in their construction account for this particular item.

This system of numbering orders does not extend to the accounts of the company, as entered in the ledger, except that in entering up accounts in the ledger it may be convenient sometimes to use order numbers for entering up items in an account; such stated, can be filed directly with the contract, and in case of any question being raised by the customer, as to what material belongs to him, or to the company, a simple reference to the file will give this information.

All work of whatever kind done should be charged to some account in the ledger, and a convenient division of accounts to which items should be charged, will be found to be as follows:

Construction.—All poles, wire, insulators, cross-arms, and other material used in the construction of lines, whether overhead or underground. All fixtures, cranes, sockets, or wiring for incandescent lamps; and in general everything attached to a customer's premises, including any tools used for this work.

Machinery and Fixtures.—All dynamos, and parts of same; belting, station instruments, and switches; and all other movable apparatus in the station.

Motors.—Where the company own such.

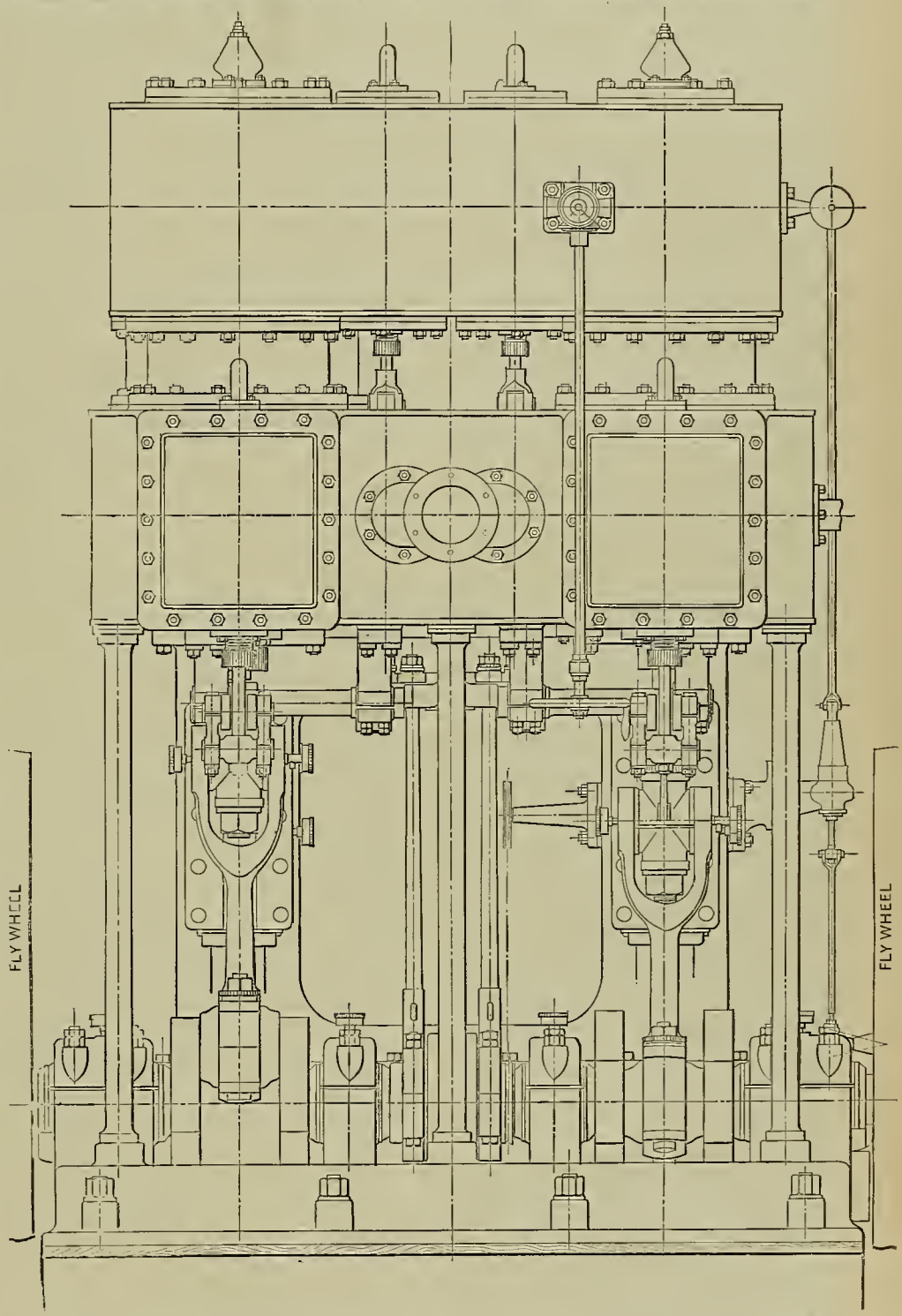
Office Fixtures and Furniture.—Including all furniture in and about the station.

Station.—All real estate, buildings, engines, boilers, foundations, pumps, piping, shafting, and any fixed scales or machinery.

Patent and Legal Expenses.—Of every nature and kind.

Store Room.—All material and supplies of whatever kind to be charged to the several departments as issued. These various items should be, of course, considered as unavailable assets.

In what are known generally as the "Expense Accounts," a convenient division will be found as follows: Advertising, carbons, fuel, insurance, interest and discount (if any), interest on bonds and mortgages, lighting supplies, including incandescent lamps for renewals, shades, globes for arc lamps, and dynamo brushes, and other material of this nature. Machinery Repairs.—All repairs to dynamos, armatures, station instruments or switches, arc lamps or parts of same. Maintenance Repairs.—Being repairs to poles, lines, etc., converters in service, meters, and other appliances used or located outside the station. Shop and Station Repairs.—Repairs to buildings, boilers and engines, piping, or any fixed machinery. Printing and Stationery.—Of every kind and nature. Salaries—To the officers of the com-



DEVELOPMENT OF GENERATING STATIONS FOR INCANDESCENT LIGHT AND POWER.—TRIPLE EXPANSION ENGINE.

pany Wages—Of the employes to be divided proportionately to each department, as explained above by the system of order numbers. Oil and Waste.—Of every kind. Taxes.—Of every kind.

Of course many of these items can be put together under one head if desired. The extent to which the various accounts are to be itemized is a question for the decision of the company, but it must be remembered that in work of this kind, the more that is done in the way of saving labor, by having the books and forms printed, the less there will be left to fill in by the employes, and the more chance there will be of their doing so correctly. Especially should this be taken care of in arranging the forms for line foremen, since it is often very inconvenient for these men to fill out their forms when out in wet or dirty weather. A convenient arrangement for this purpose is to give the man a leather case, which will just hold one of the superintendent's orders, when doubled through the center, and an indelible pencil with which to sign their orders on the storekeeper.

The only other account which is kept separately, is the storekeeper's account. He should have what is practically a ledger, in which he enters up, on one side of the page all material received, to the debit of the storeroom, and on the other side, all material issued, to the credit of the storeroom. He can thus have a page to each item of supplies, and having a column for the amount in stock, deduct as he issues each order, the amount of the order. He can tell at a glance how low his stock is running, which enables him to issue a requisition on the office and have the material ordered in time to prevent running out, and insert returned items.

In order to prevent the necessity of foremen sending in three or four orders for small lots of material, it is better to have a system of returning material credits, so that a foreman who requires five or six hundred feet of wire, can give his man an order on the store for a reel, the weight of which is taken when it leaves the storeroom. The work being completed, the balance of the wire can be returned to the storeroom, and the storekeeper makes an entry on the stub of the order remaining in the foreman's order-book, crediting him with so much material returned, and makes, of course, a corresponding entry on his report of the office. In the same way any material which is taken down and returned on the conclusion of a contract, is returned to the storeroom, and a credit given for it.

If the material is simply to be counted as scrap, it is sold, or set aside for sale, and entered up in the storeroom book in that way; but should the material be fit for other use, such as crnnes for arc lamps, etc., they can be simply entered up as returned tools.

An excellent plan is to have a record book for all material, etc., in the station the engines being distinguished by numbers; the dynamos ditto, and all converters. The location of the engine is entered in the book, and the duty which it is doing, and any repairs made to it are charged up against it in this book. This may not seem of much importance, but in the case of converters, arc lamps, meters and such materials, it will be extremely valuable in keeping track of them.

Cases have occurred where converters have been removed from buildings when repairs have been made, and have been lost sight of for months, but a book of this kind enables them to be traced, since every change of location or repairs are entered in the book, consequently it is easy to follow them through their wanderings. Not only this, but it occasionally happens that one gets a lamp or something of that kind, which is absolutely bad, that is, it seems to be perpetually needing repairs, and it may be that in such case it will be a good deal cheaper to simply consign it to the scrap heap and get rid of it entirely. In such cases the one which takes its place can be known by the same number, and it will make no difference in the correctness of the record, since the fact that it is a new lamp will be found recorded on the page of the book devoted to that particular number.

In order to enable accounts to be kept correctly in the ledger there must be, of course, some regular division of duties, which the men themselves should thoroughly understand, in order that in charging up their time they may be able to charge the proper number of hours to the proper accounts. In a large station, moreover, there must be, and will be always a certain amount of jealousy between the different gangs of men, and there is very apt to be some clashing owing to fancied encroachments of one gang on duties properly belonging to another. Arising as this generally does from an entirely mistaken notion, it is all the harder to combat, and the best way is to prevent its arising at all if possible.

The division of duties, somewhat as follows, may be found of some assistance to this end: The superintendent is in full charge of the station, and all work done by the company of any kind or description. If the station is large enough for the superintendent to require assistance in his duties, he should have a man who can attend generally to the making out of his orders, examining reports, etc., so as to take as much of the routine work as possible off his hands. In this way, during the superintendent's absence, his assistant, who needs be little more than a clerk, immediately takes his place, and while he may not be able to decide just how any particular piece of work should be done, he can often decide whether it shall be done at all or not, or whether it shall wait for the superintendent's return. Under the superintendent comes the chief engineer, chief dynamo man, chief lineman, and chief incandescent wireman. Under the chief dynamo man come the various dynamo runners, although the chief engineer may also be able to take charge of the dynamo room, in which case it would be made a department, so to speak, of the engine staff. Under the chief engineer come all the engineers, foremen, coal handlers, etc.

In the absence of the chief engineer the engineer on watch takes his place, and the same with regard to the dynamo man. The chief lineman should have under his care all pole lines and outside construction of all kinds, including all arc lamps and all high tension wires of any description; also the care of converters to the first cut-out on the secondary side. He should also have charge of the carbon setters and arc patrolmen. The chief wireman should have charge of all inside wires in buildings where such are under the control of the company, the care of all lamp renewals, incandescent patrolmen, and generally of all material and work from the first cut-out on the secondary side of the converters. The storekeeper, of course, has his own duties separate from all of these.

The only reports necessary to be made will be found to be the engineer's log, for which there should be two books provided; one for the day run and one for the night run, to be filled up by the engineer on watch and turned in to the superintendent's office every morning for examination. In this should be entered the amount of coal burned, at what time each engine was started and stopped, and the other usual items; the name of the engineer on duty, etc.

The dynamo room log should be much of the same style, but include a reading of the load on each machine, taken at twenty minutes' intervals throughout the whole run. This report, with the amount of coal burnt, gives an excellent check upon the fireman and upon the quality of the coal.

In one station, which is purely incandescent, this record has been so well kept that it has been the means of saving the company hundreds of dollars, since any perceptible increase in the amount of coal burnt per ampere hour, as shown by the engineer and dynamo room reports is blamed at once upon the coal. This has resulted in several instances in the detection of a poorer quality of coal being furnished when the firemen using the coal were not able to detect the difference, but the coal dealers on being taxed with the matter, fully owned up.

The various inspectors and patrolmen should fill out a printed form, giving the number of arc lamps on the circuits they have charge of; if any of these lamps are out or burning badly, and between what hours, and the probable cause, as far as they can judge. It will be found much cheaper, however, to keep constantly on hand a few lamps known to be in good condition, and wherever an arc lamp does not work correctly to take it out at once and bring it to the station for repairs, rather than let the inspectors attempt to fix it in place.

The storekeeper should make a report daily of all material received and issued, which report can be used by the office as a check upon bills received for material, since the bills will be laid away until the storekeeper's report shows that the material ordered has been received and in what condition, and if any expenses have been incurred which should be charged against the bill. The use of forms for all these various purposes will make the actual bookkeeping of the station very simple.

If the company is fortunate enough to be in a position to simply sell current and nothing else, their cost accounts will really be the bulk of their work. Should they, however, have to sell arc lights the matter then becomes a trifle more complicated. The customer's account and bill will always be made up from his contract, renewals of lamps being charged up against his account as he receives them unless the company furnishes renewals, in which case, however, it is well to keep a record of renewals made, in order to put a check upon any excessive breakage. In some cases the customers who receive renewals for nothing have been caught supplying a customer, who had to pay for them at half rates; or boys will bring in broken lamps for renewals from customers who are not entitled to them, giving the name of a customer who is, in order to get them for nothing. A convenient check upon this latter scheme is to have a small stamp to mark the butts of lamps were it possible, or to have some secret mark upon the lamps to find whether they are issued from the company's office or not. This little device in one station has resulted in finding two or three people who made a regular practice of this kind of business, which of course was all dead loss to the company.

The forms for all these accounts will be found to vary greatly, according to the amount and kind of business the company is doing.

If a sufficient number of members of the association think well enough of this method of keeping accounts to agree to use it, if it shall be put in workable shape for them, I shall be pleased to get up such a system of forms and furnish them to them. In many cases it is the amount of detail required to think out and work up such forms that prevents their being adopted, where if they could be obtained for use they would be gladly used.

Secretary Garratt stated that a letter had been sent to the association by Fred H. Whipple, general manager of the St. Louis Exposition company. Its purport was that the St. Louis Exposition company had requested the American Institute of Electrical Engineers, the National Electric Light association and the electrical fraternity at large each to appoint one of a committee of three to pass upon the awards of merit and the medals to be given at the St. Louis Exposition. Mr. Garratt said the American Institute of Electrical Engineers had named Prof. Hering as its member. President Edwin R. Weeks was then selected as the representative of the National Electric Light association.

The convention adjourned to 2:30 P. M.

Thursday Afternoon's Proceedings.

The convention was called to order by President Weeks at 3 P. M., who introduced A. J. De Camp of Philadelphia, who addressed the association on the subject of the cost of products to central stations. Mr. De Camp referred to a form for recording products, which was as follows:

REVENUE.	AVERAGE COST.	AVERAGE REVENUE.
Lights		
Other sources		
Total revenue		
Less rebates, etc		
EXPENSES.		
Pay roll, electrical department		
" motive power "		
" office		
General stationery		
" cartage		
" expressage		
" horses		
" tools		
" miscellaneous		
Taxes, licenses, etc.		
Interest		
Extraordinary		
Total general expenses		
Coal		
Carbons		
Engines, oil (machinery)		
" " (cylinder)		
" waste		
" belts		
" shafting		
" miscellaneous		
Boilers, furnaces		
" tubes		
" piping		
" pumps		
" miscellaneous		
Dynamos, oil		
" waste		
" belts		
" brushes		
" armatures		
" commutators		
" segments		
" miscellaneous		
Lamps, spools		
" cut-outs		
" armatures		
" carbon holders		
" carbon rods		
" insulations		
" globes		
" miscellaneous		
" incandescent		
Line, poles		
" wire		
" miscellaneous		
Net results.		
Previously reported		
Total for the year.		
Daily average (Sundays excepted)		
Sunday average		
Total hours burned		
Average		

Mr. De Camp's address was as follows:

Cost of Products to Central Stations.

BY A. J. DE CAMP.

It occurred to me at the first of 1886 that we were a manufacturing company, differing in no essential from any other manufacturing company; that our business was the production of light which we sold as a light. Therefore we wanted to know the cost of that production, on the same principle that a manufacturer who made a yard of cloth and sold it on the market at a given price, wanted to know what it cost him as a whole. Further than that, in order to conduct his business properly, he wanted to know in what that cost consisted. It therefore remained for me to divide that cost up. In doing that I bore in mind there was a fault or a defect, in too much detail. That any concern should at least have one head who should be able at all times to appreciate and understand the condition of its business; one in whom it should confide to the uttermost. Otherwise, I should have spread this thing out in greater detail. In our own cases as it existed then we had three classes of products, all of them alike. The first were day lights running from 7:30 in the morning until 6 and some of them up to 10 at night. Next, evening lights, starting at 3 or 4 o'clock in the afternoon and running until 12. Next, all night lights, starting at 6 in the evening and running until say 6 o'clock in the morning Each one of these three classes lapped into the other. It was utterly impossible so far as I could see to find just exactly what was the relative cost of those three classes of products Not seeing a way clear to do that, I knew of no better way than to strike a general average. I think we have a pretty good way of doing it; I do not know as there is a better way. Our business is divided up into the three classes of business. Those reports come into me at the office, and the report shows that we rent a certain number of lights from 7 in the morning until 6 in the afternoon, aggregating a number of hours so much, the same with the evening and the same with the all night lights. This report is made out at the end of every month. In order to make that, we take the aggregate number of lights and the aggregate number of hours We put in our first line the number of lights. We carry into the second column over to the left, what we had charged for those lights, what our light account stands charged with for that month. We have there other sources that are hardly worth mentioning; but it is to cover a little motor service which we have; it only amounts to four or five hundred dollars a month. We convert that into what is equivolent to lamp service. These motors are all run in the service rendered by the day service or its

equivalent. Then we deduct from that amount which we have charged against the lamp account all rebate, all discounts, and all claims of whatever character that have been presented to us during that month, and which have been accepted, and deducted from that amount, and carry into our outside column the remainder, which gives us our charge against the light account. Now, we have in our method the charge for lights and schedule of prices. It is based on the service rendered; for day service we charge so much, for evening service we charge so much, and for all night service so much per light. But that rate is again charged according to the kind of contract the party gives us. The best contract we can get, in our estimation, is a contract that runs for twelve months, in which we make the lowest price, as the short contracts are almost invariably made to cover the winter months, which are the most valuable months of the year. For instance, if we have a contract for six months, from the first of October to the first of April, we have put out of our possession a lamp, and get only a certain revenue for six months. At the end of six months that lamp is thrown back on our hands again and we are deprived of any additional revenue. Now, for that class of service we charge a higher price. In order to get the averge we take that total amount charged against lights, take the total number of lights charged during the month, and divide it into that number, and it gives us our average cost and average price received for lights during that month.

So much for the starting point, which is our revenue account. Of course, to get at that we have to deduct our expenses. Our method of arriving at the cost of these lights is precisely the method of arriving at our revenue. It is an average cost. By dividing our total expenses by the total number of lights, which we have divided into our total income, we get the average revenue from the lamps. That certainly as a whole I think is an undisputed way of arriving at the cost of that product, and the average revenue received from it.

In regard to arriving at the average price received, that is arbitrary. There can be very little chance of making a mistake in that, but in the other there is great room for mistakes or discrepancies.

Now, having arrived at that cost of production, no man can prosecute his business and take care of it without being familiar with the various items of which that cost is made up. I have seen fit to divide that under, first, pay roll; second, general expenses; third, taxes, fourth, interest; fifth, extraordinary; sixth, coal; seventh, carbon; eighth, engines (I mean by that, repairs and maintenance); ninth, dynamo; tenth, lamps; eleventh, lines. Now, those are our general heads of items under which we group our costs. This statement is made up for my own particular use, and for any other who sees fit to use it; but as they go into a detail which the average officer of a company has not the time or disposition to take up, they are not material to this statement, but for explanation here I will say we divide the pay rolls into three classes. First, the electrical department, which pertains to all matters under the electrical head, or general superintendence. Second, the motive power department, which pertains to all matters in charge of our chief engineer. Third, office pay roll, which has been in my own particular department. The general expense we g oup into stationery, carts, expressage—freights—horses, tools and miscellaneous items. This generalizing can be extended almost indefinitely. Taxes, we cover into that, state, municipal, water rents, insurance, our license charges, and I believe that is all. They appear on our books not under separate heads, but as separate charges, with the understanding that they go into the general books of account. The interest account covers any fixed charges of interest either as against us, or credits where we have made discounts. The extraordinary account means simply this: It is the experience of every corporation—certainly my experience for a number of years—that we have never yet had a year in which we have not been subject to some expense, some charge, which we could not foresee at the commencement of the year, such as legal expenses, damages and such things as that.

Now, I will stop there, as our expenses are divided there, and call them all the general expenses. In regard to these three items, I will have to go back a little to explain. When we get to the end of this month, and our books are ruled in sheets for that purpose, you can get the result. I am prepared to say that I will give any of our board a check or ca h for that return at any time. They can have it. They can keep it. I do not want it. That is what I mean by the absolute net revenue of the corporation.

That you may make comparisons from one year to another without trouble, you have got to in some way eliminate these three unknown factors, taxes, interest and extraordinary expenses. In the city of Philadelphia the bulk of our taxes, in order to get the benefits of what discount can be had by prompt payment, should be paid or at least three-fourths of them should be paid in the first three months of the year, and it is a very considerable item I think that our taxes in Philadelphia, coming under that head amount to about $15,000 in the course of a year, and the result would be, if you had them charged off at the time that they were paid, that you would have a variable result from month to month on your returns. The same way with the interest account and the extraordinary account; therefore, at the commencement of the year I think this is a wise and convenient way of handling those three subjects. I refer to the year previous. I see what the taxes were. If the tax account has been so much, I divide it by twelve, as there are twelve months in a year. That one-twelfth I charge off every month, having an account on the ledger with these three items, and debit and credit these accounts. Experience enables me to see how I am coming out at the end of the year. I seldom get more than $300 or $400 out of the way, one way or the other. That method of charging the proportionate amount off every month enables you to keep the correct run of your business.

The total account we divide the same way by the number of lights, and the same way with carbon. Engines I have subdivided again into machinery oil, cylinder oil, waste, belts, shafting and miscellaneous expenses. We have to draw the line somewhere on the charges on this expense, and therefore we make a rule where this line shall be drawn that is known to everybody whose business it is to make these charges. For instance, on the engine, all belts, such as counterbelts, main belts on the engine and anything up to belts that go to the dynamo, is charged against the engine account. The shafting expenses and all repairs to the shafting are charged to the engine, and so with the pulley and everything of that kind. Boilers and all repairs to furnaces, the repairs to tools, piping and the pumps and all other items, which are innumerable, are classed under the head of miscellaneous. The dynamo expense is subdivided into oil, waste, belts, brushes, armatures, accumulators, segments and miscellaneous items. Lamp expenses are divided into spools, cut-outs, armatures, carbon holders, carbon rods, insulation, globes, miscellaneous and incandescent expenses. The incandescent expenses are put in there because our expenses on that are so small that they do not amount to anything. The line expenses we divide into poles, wire, and miscellaneous items.

Our books are so ruled that they correspond to every one of these items. The storekeeper has charge of all these supplies, which he has obtained by making the proper request of the purchasing officer. When this account is summed up at the end of the month, we take each one of these departments, having found what the total expense is. We have to pay that amount. Now, it is to be divided among these different heads. The result of it is, that I think any one who would go over these statements, for the last two years particularly, would be struck with the uniformity of the expenses under these different heads. If any one month shows a marked increase of expenses on any particular item, it is very short work to put your finger right on it. I do not think it is worth while for me to go into the starting points of these. Mr. Smith gave you that very clearly. His idea, as expressed in his paper, of handling that part and getting his stock out into the proper channel is very good, and does not differ very materially from our own way of doing it, but when we get this through we have got in that statement every manner and form of expense that it is possible for us to incur, and certainly all the money that we have spent. You may have an expense item against your engine this month of five times what it was last month, and five times what the average has been. It may be caused, as it was in one of our statements, recently, by having to rip out the cylinder. There was an expense of $300 or $400 in that particular item, more than it had been for the year previous, but that immediately goes into the expense account; it is not a continued expense; it is not, as Mr. Field termed it, "variable expense." It is an extraordinary expense in one particular item, and such expenses are bound to come sooner or later. If I see that the cost of our lights is running along uniformly from month to month, my interest in that statement is a general one. If I find that the increase in cost for one month has been 10 per cent. or 15 per cent., I want to know why. I immediately go to these points and see. If it is not a legitimate increase I cannot help it, but I do know that it has gone into the expense account, and that is the end of it. If it shows a decrease, I am interested, because if it is a legitimate decrease in the cost of that product, I want to see if it can be maintained. If it is a decrease in some little peculiarity in that month's business, of course I regret it is such. If you follow that out, and subdivide the expenses, and have your two columns of average cost and average revenue, and compare them from month to month, I know of no better way of keeping track of your business, nor any better way of educating yourself up to the true state of your own affairs. Of course, these results are governed somewhat by the amount of service you are rendering. If we find from the statement of one month that so many lights cost so much, and our average run on those lights is twelve hours, and next month our average run for the same number of lights is ten hours, and our cost is reduced correspondingly, then we have made no particular progress. The expense item has got the benefit of a shorter run. The purpose of this sheet is the use that I make of it in turning it into a board of directors who know what they want, and what they want is the net result of your statement. But for the guidance of others, who are responsible for running the station, you must go into further details. You take the whole number of hours burned as an aggregate. In some of our statements it is 600,000. That will enable you with very little work to find out what it costs you per hour to run your lights. I do not think it signifies anything at all so far as enabling you to fix the price of selling your product, but it does enable the engineer to say: "Last month our coal cost us half a cent an hour, or ten hours five cents," and next month he comes and says it costs four and a half. That is all right, but if it has been because of the relative difference in the nature of the service he has rendered, it does not amount to anything, but it is a point which aids the party who is to do this work to carry it out.

All of our supplies are drawn out of what we call the merchandise account.

Of course, we sell some little things, and sell them at a profit when we can, but in charging these things out for our own use the instructions are to charge them at cost, in one sense, but a perfected cost, to give the company the benefit of a little margin to cover waste and things of that kind. For instance, it is our custom, if wire costs 16¾ cents, to charge it to our own account at 17 cents, making nominally a profit of one-quarter of a cent on that wire. We fix the value on our merchandise stock at such an amount only as is necessary to keep us supplied in our business. For instance, we say $5,000 of stock is enough for this purpose. We have a merchandise account on our ledger. It stands at $5,000. If we charge everything out to it at cost, and put everything into it at cost the difference between our sales and what we put in should represent the difference between our two balances at the end of each month. I cannot always do it, but if a rule of that kind is followed, and I look at our merchandise balance, I go to the storekeeper and say: "You seem to have $1,000 more stock than you had last month. What has been bought? If it cannot be accounted for without much trouble, I want an account of that stock taken." If it is the other way, and shows the decrease of $1,000, or some amount which I think is out of the usual order of things, I want to know in what particular it has been reduced. If it cannot be pointed out, an account of stock ought to be taken. We take an account of stock every six months. The custom of charging a slight margin on the stock against ourselves has always resulted, and always should result, in a credit balance at the end of the year, or six months, when we take stock. In the eight or nine years that I have been running business in that way, there has always been a margin over and above what I have reported from month to month.

Another thing, if you keep your stock down to the minimum and they throw the whole thing overboard, they can not hurt you much. My policy is to keep a low stock, just large enough not to interfere with the means of running the business. That method of keeping your books gives you a certain basis for the cost of your lights. It gives you certain returns which you can rely upon as accurate, and it is very easily kept, and if Mr. Field is here I want to say again that I see no harm in that method of keeping your accounts for variable expenses. The expenses vary from month to month undoubtedly, but nothing that should enter into a general report.

It is a mistake that your income from increase in business so far outstrips increase in the cost of production. I am giving this from memory, as I did not think the matter would come up, and have not my notes, but I am not a great ways out of the way. I say, take a respectably sized station. Suppose that an increase of from 600 lights to 800 is made, and results in an increase in cost of 10 per cent.; an increase of 25 per cent., that is, from 800 to 1,000, results in an increase of 8 per cent. in cost; an increase again of 20 per cent. results in an increased cost of 7 per cent. Now; that is pretty nearly correct. We have thought of it. I know there was a time in our history when we started with 320 lights, I think, and we had so much expense. It was thought when we doubled it, we would have a very slight increased expense. We did double it, and we did not double the expenses; but it did treble the expenses we expected to have; and that has kept right along, and I do not know how to check it.

MR. FRANCISCO: I consider this matter of central station accounts as one of the most important subjects that a central station man has to deal with. During the past year I traveled over quite a section of country, extending from Boston to Washington Territory, and as far south as this city, taking in nearly all the stations, numbering several hundred. In the course of interviews with the station men at the different places, I looked up this matter of accounts. I found that a large number, in fact the greater portion of the ordinary stations, what we call the smaller stations, kept no account whatever. They would start their plants, their engines and lights, and at the end of the year struck a balance. In a great many cases they found the balance on the wrong side, but they could not tell where it went to, or anything about it. Now, of course, in running an electric light plant, these things must be considered. I have adopted almost identically the plan presented by Mr. De Camp. For two years I have worked on this plan. I have it arranged for the incandescent light. At the end of the month the figures can be inserted, and that is all there is to do. Now, of course, if I am running an arc light plant, and I find that Mr. De Camp is running his light for a certain cost per light, while mine costs me one-third more, there must be some reason for it. In keeping an account like this, you can trace out where your leak is and solve it. For illustration, I take an account of coal Every pound of coal that goes into my furnace every night is weighed, what we burn from the time we sta t to 12 o'clock is weighed, and also what we burn from 12 o'clock until morning, and we get the average per hour. Now, awhile ago I was away from home. When I came back I found that the coal accounts were far above what they should have been. I called upon the engineer for an explanation of it. He said: "I do not know what the reason is; we have been running just the same way." I went to work, after I had investigated the thing awhile, and telephoned for the coal man and asked him if he would not call at the office, and when he came up I showed him the result. I said: "There is so much money that you want to give us credit for on our coal account." He could not, of course, see it as I did, but nevertheless he gave us credit, and there we saved several hundred dollars. It is just as Mr. Smith stated this morning. There is one benefit to a central station man in keeping an account. I know in running these small stations the men cannot keep an account as they do at the large ones, because there are many stations where a man has to perform all the duties, from president to errand boy. Of course, he can simplify the matter to a great extent. In keeping his account he can collect the different items, and get some idea of what it costs. If the central station men will adopt this plan throughout the United States, it will be of great assistance. There are some of us who may not want to give away our secrets, but if I found one man whose lights are costing him a certain amount of money, while mine are costing a good deal more, he would afford me an explanation, and give me the benefit of his experience. In this way, if there is a leak in my business, I can stop it. I believe that every central station man, above all things, should keep these accounts. I have seen the benefits to be derived from keeping accounts many times, and especially in this business, because there are so many places where, if you do not keep track of your expenses in those things, they are going to eat you up.

C. J. FIELD: The stations which I have taken my basis from have been incandescent stations, while the stations Mr. De Camp has referred to are arc light stations. That

will explain much of the apparent difference in the results. Mr. De Camp doesn't say where on his list he gets his fixed expenses and his variable expenses. I will say the stations I have been familiar with that kept such an account as this, are incandescent instead of arc stations, but the principle is largely similar to the basis on which I figure the fixed expenses and variable expenses. I did not put in variable expense any expense of a break-down, or for armatures and dynamos or anything else. That is all in your general operating expenses. My variable expenses were those which you got by taking a station account, for instance, last year, when it had 10,000 lights, and taking it again the 1st of January, when it had 20,000 lights on, and seeing that there was a fair comparison, and seeing that there were included all those other charges which it is practicable to observe, and charging up an average over the twelve months. I know we have done it in our station, and have made an average. The month I have taken is a fair representative month, and shows a comparison on which we can rely without any danger of incorrectness. It shows us the practical information which we want.

There is one company that takes reports from 100 or 200 of its central stations, not of details, but of general expenses, operating expenses and earnings, and publish it each month for the benefit of their other stations. From this it will be seen that one station is using so much coal, and producing a given result. Of course, there are local conditions. One place gets coal at 10 cents per ton and another pays $5 per ton, and these are things that must be taken into consideration. But when you take into consideration all these things, you are trying to get a result that will show where your mistakes are, show where your men are not doing right, and point out the remedy to correct the errors that will enable you to get the result you are after.

In regard to the proportion of variable and fixed expenses, I will say, that since this morning I have been looking up a few facts and data, and I find one large station is down as low in variable expenses as only 21 per cent. of the total expenses. In other words, that station has doubled its business, and has only increased its expenses 21 per cent. Of course, these things are going to vary, but there will not be so great a variance that the matter cannot be equalized, and a pretty fair result can be reached. I think at the last convention at Niagara there was a committee appointed. Mr. Foote, if I remember right, of Cincinnati, who was going to prepare for the benefit of the association a simple set of operating accounts and expenses. I do not know what has been done with that; but it seems to me that the Edison association has done that, and has found it a great benefit. It seems to me it is going to be of much use to the members of this association; it is going to bring this association to a basis where it can be supported more and more, and give the true benefit to its members for which it was established

H. Ward Leonard of New York: If I understood Mr. De Camp correctly, he gave as an instance that a station running 600 lamps, which increased to 800 lamps, increased its operating expenses about 10 per cent. Is that correct, Mr. De Camp?

Mr. De Camp: The operating expenses decreased 10 per cent. per light.

Mr. Leonard: A decrease per lamp?

Mr. De Camp: Yes, sir.

T. Carpenter Smith: I think if we want to get comparison between central stations, there is one thing that must be eliminated, and that is the dollars and cents of the question. It is all very well for us to meet here to help one another, if we can. But there is an inborn objection to letting anybody else know our business. If another central station man comes to me and says, "How many cents or fractions of a cent does it cost you to produce one sixteen candle power for an hour?" it is very likely I won't tell him. But if he says to me, "Taking your fuel, your rent, your taxes, your affairs and so on—taking these different items as amounting to 100—how many of that 100 do you charge for fuel?" I am perfectly willing to give it to him, because that don't tell him what it is costing me; it is giving the percentage of cost, and I have no objection to doing that. Now, if central stations all over the country work in that way, the man in Albany finds his lamps are costing him 20 per cent. of the total operating expenses for fuel. Another man in some other town, who pays precisely the same price for coal, finds his fuel account is 30 or 40 instead of 20, he realizes there is something wrong, and in this way he can correct the evil. It may be in the one case that the man is using a compound condensing engine and in the other a high speed engine. In one case he may be using coal that cost him $1 a ton, and in the other case coal that cost him $4 a ton, and yet the man who is using a high-price coal will get the best result. We use a coal which costs us $1 a ton more than some others we could get, and count it the cheapest, because the item of hauling away the ashes with us is very heavy. I have been asked several times how to handle the depreciation account. I do not know of any better way of doing that than by having no extraordinary account, but one repair account; the repairs cost so much from year to year. The fact that we have had a smash-up and that repairs cost us a little more for one particular month ought not to have any effect with the directors when it was explained. But if at the end of the year it would appear they were too much, they should be looked into. We should want to keep our account near the point which was settled upon us about the true basis. That is to say, every time there is put in a new engine or a new dynamo or a new boiler as an addition, it should be charged to construction account. But when you find that the engine is worn out, and you want to change it, you charge the new engine to repairs and sell your old one for what it will bring. The only increase in your capital account are your legitimate construction expenses It is the same in a pole line. If a new pole goes in where there was a pole before, that is charged to repairs.

President Weeks: If you will pardon me, Mr. Smith, what do you do if there is a change in the market value of material?

Mr. Smith: That you will have to charge to repairs the same way. You will get the benefit of the cost when you put in a new machine. The new machine is going to cost you less than the old one did; consequently you will not charge so much for depreciation.

President Weeks: We can all remember when a sewing machine cost from $100 to $150 while we can now buy them at from $10 to $30. Will not the same be true, to a considerable extent, with regard to electrical apparatus? What will you do with that shrinkage?

Mr. Smith: If you bought a dynamo for $1,000, the first year it is worth $1,000. Every year your dynamo decreases in value; it gets worn out. When you get your new dynamo in, you get it for less money. Your capital account remains the same. You have otherwise to make a gradual drop in the value of your plant in making your annual statement. I want to get rid of the depreciation account by making it all repairs.

Mr. De Camp: A rule which, I think, is a good one in this depreciation account is this: The depreciation account is an unknown quantity; it is a conservative way of guessing at things, or keeping account. A rule like this will always enable you to be on the safe side. Merely incidental repairs are not things that affect it one way or the other. But when it comes to the general repairs, and you work on this principle, if after these repairs are made, is your engine or your dynamo or your boiler as good as new? Then your construction account is not affected. Overlook all charges or all depreciations, if not connected with any general expenditure of money.

Mr. Smith: I would explain, in speaking of the capital account, that it is always a liability, I mean in estimating your assets. It would be a simple way to keep these assets from year to year to put them in at the value for which you think they could be replaced.

A. J. De Camp: An arc plant is made up of engines, boilers, dynamos, lamps, lines and general station construction. I think this would be a good plan to maintain your construction account: Calculate what your plant is worth in the income power per lamp, because your lamp is what produces your income, and nothing else. Ascertain what it costs per lamp per dynamo capacity, boiler power, engine and dynamo. Fix it in some way—say your plant is worth $300 a lamp. Well, you may have an engine capacity of twice as much as you have lamp capacity; credit that with that amount. Now, on your construction account on your books fix the basis of $300, or any other amount, which you, in your judgment, think is a proper amount, or that the construction account can stand. Charge to your construction account any addition during the year, and give it due credit. Then take your balance at the end of the year and see whether you have exceeded your estimate of what you thought your construction account would be. If it is increased 10 per cent., why, charge it off. It will make your surplus or your profit and loss account that much less. If you assume that the market value of your plant is a certain amount, do not imagine it can always remain that way. If the price of construction is decreased, then you have to reconstruct your construction account, because your plant is not worth that much. Now, the rule is to charge that amount of depreciation into your expenses and get rid of it every day, instead of having a yearly account, and you cannot make any very great mistake.

F. A. Wyman of Boston: My experience has been that this so-called construction account should be called a destruction account. This running of expenses into the construction account destroys or ruins more people than any other item in the business. It does not seem to me right to build a new station, run it ten years, let it pay 10 per cent. per annum, and at the end of ten years have to build it completely over again; so that your plant is only worth 50 cents on the dollar. It seems to me it is better to start out and pay a 5 per cent. dividend and charge the other 5 per cent. to depreciation. Of course, it takes courage to charge this up. A party making lights very cheaply, and having exclusive control of a city where they are getting a high price, tries to make his operating expenses as large as they possibly can be made; but in a small town where there is only a small dynamo capacity, they try to make their construction account as large as it can be. You have to steer between the two. I wanted to give you a practical illustration. About twenty years ago there was a gas-plant started in a good-sized town in the East with $100,000 capital. The other day in looking it up, we found they had a paid-in capital of $35,000. They had $35,000 worth of property left. The other $65,000 had been paid away in dividends. They hadn't kept any depreciation account; it all went into the construction account. I wanted to ask Mr. De Camp in regard to the taxes. I understood him $15,000 a year. Now, I would like to ask if he buys water by meter?

Mr. De Camp: Yes, sir.

Mr. Wyman: Why should not that be charged every month the same as you charge your coal?

Mr. De Camp: There is no reason why it should not be done. It is a matter of detail.

Mr. Wyman: Does it cost you more to run a light in the winter or in the summer?

Mr. De Camp: It costs us more in winter, because the hours are longer.

Mr. Wyman: I mean hour by hour?

Mr. De Camp: I do not think I could answer that question. I do not think it does, but mainly for this reason: The month of July is our short month; that is, we are running at the smallest number of lights. During the month of December we are running everything we have, and we have the benefit of having everything utilized; and consequently, taking the month of December for the last six years and comparing it with July, I would rather be inclined to think that the average cost was less per light for the month of December than for July.

Mr. Wyman: Where you have to put wires inside and outside, do you keep separate accounts of them?

Mr. De Camp: Yes, sir.

Mr. Wyman: Do you think that the inside wiring should go into current expense or construction account?

Mr. De Camp: We put the wiring that goes in there into our construction account. That is a matter in which I sit in judgment. Anything that is likely to be lost and all the labor is charged to expense.

Mr. Burleigh of Camden, N. J.: I think there should be no such an account as a depreciating account. In arriving at that calculation I was interested in watching the plan of the Pennsylvania Railroad Company, who have given a great deal of attention to accounts and the best plan of arriving at values, and they do not have any depreciation account. They aim to keep their road and its equipment up to the standard all the time, and charge it to expense. Anything new that aids their railroad is charged to capital, and that which replaces what is worn out is charged to expenses.

The Chair: What do they do in case of change in market value? Do they make any allowance for that?

Mr. Burleigh: No sir. Take the case of a locomotive which is valued as scrap at perhaps $1,000. That is replaced with a new engine costing $8,000 which is charged to expenses.

Mr. Wyman: I would like to ask Mr. Burleigh if the Pennsylvania Railroad company has established the value of its road on its earning capacity?

Mr. Burleigh: They know exactly what they have got, and so can we know. They want to know whether they have a railroad worth what they have it capitalized for. We want to know the same thing. They have to take an account of stock, just as we do. They know just what the value of their railroad is, and it is not the earning capacity in that sense. We are so particular in our company in Camden that we have everything in that direction go to expense. If we find by an account of stock that the values of what we have on hand are not what we are capitalized for, the board takes action and charges it to expense.

Mr. Lockwood: I am interested in this subject because about a year ago I asked Mr. De Camp of Philadelphia, and one or two other members of our association for information about their methods of keeping accounts, and in what manner they found just what they were doing and knew what to count upon as the result of the electric light business. I believe, from what I have heard of Mr. DeCamp's method and what I have heard people read about it to-day, that the plan of going down to the basis per month is the best. I believe the nearer we can bring the expense down to that basis, so that we know each month what we do, and not have to wait until the first of January or whatever date we take our inventory, the better we will be informed and the better we can carry out the improvements suggested by the results. I had a case in point in a company with which I was connected. We found just what the major part of our accounts was per month, such as coal and labor and accounts of that character and we charged this into the total running expenses for that month. Then we found that the interest and taxes and accounts of that description, repairs included, varied very greatly. The interest and taxes, it is true, we had to pay only once a year, but the repairs we studied over and arrived at this solution: We created what you might call a balancing sheet, and we estimated at the beginning of the year how much we would likely have to charge up during the year for taxes, insurance and accounts of that description, and then we started in and charged up each month in our monthly sheet what we thought was the proportion that that month would have to the total year. If we did not pay our taxes until the ninth month in the year, there was accumulated upon this balancing sheet during those nine months certain amounts, and we credited the same amounts in the monthly sheets as in the balancing sheet and then taking the proportionate amount of that nine months we charged up the proper proportion in the remaining month. We adopted the same system for repairs. Instead of charging up each month just what the repairs were, we estimated as nearly as possible what they would amount to in each year, and then charged up one-twelfth of the amount we had estimated for the year, and as the end of the year drew near, we could see on our balancing sheet what was going to throw us out of our estimate. We divided it among the remaining months, and charged it up proportionately to each month in the year. I believe that in this way we will better know how to make improvements from our investigations.

One point spoken of is how to charge up inside wiring. We did it this way, and we may be right or wrong: We determined to charge consumers for their inside wiring at a fixed price unless the amount of wiring was very largely out of the usual course We put it up for five dollars a lamp, and though it may cost us ten dollars, we charge that up, and if there is a loss, it goes to profit and loss, and if there is a profit, we make the proper entry of it. Then it can be carried as a merchandise account, and I think that is a very fair way of doing it. As to repairs, I think the right way is to keep your station in every respect up to the highest standard. If you simply make up for what is depreicated by wear and tear, I believe every cent of that should go into the running expenses and be divided up on the system of the balancing sheet and be distributed through the different months of the year.

High Voltage in Virginia.

Mr. Phelps, of New York, read the following telegram:

"New York, Feb. 13, 1890. Just returned from Richmond where bill for restriction of voltage in Virginia has been reported adversely by the unanimous vote of the senate committee after two days' argument. It was supported by Edison in person, and the electrical executioner; it was opposed by Westinghouse representatives aided most efficiently by local companies at Norfolk, Alexandria, Petersburg, Lynchburg, Fredericksburg, Richmond, Liberty and others. R. W. Pope.

M. D. Law of Philadelphia, presented the following paper:

Nine Years with the Arc Lamp.

BY M. D. LAW.

In being honored with an invitation to read a second paper before the National Electric Light association, I cannot help but feel that there were points of interest to some of you in my other paper presented at the Niagara Falls convention. The subject of this paper is one that is of interest not only to every central station man, but also to those who handle arc lights in isolated plants; and if I can give you but one point that is of value, I shall feel amply repaid for my labor. There are a large number of irregularities in arc lamps that can be remedied by a judicious study of their actions, and, after the cause of their trouble has been found, it should be remedied, even if the lamp has to be rebuilt.

In order to find the special trouble that arc lamps are subject to, a careful record should be kept of each and every lamp. To do this give each lamp its individual number, which should be firmly attached to the lamp box and never removed, then by the use of a numbered book, allowing a page for each lamp, a record may be kept of all lamps, where they are, when changed, with the kind and amount of repairs.

This method of keeping a lamp record allows of finding the peculiar trouble that the lamp is subject to, and the remedy can then be applied, preventing any further trouble until the washers, clutches, rods or bushings, have to be removed. If a lamp is continually being changed for the same cause, there is some one thing that is radically wrong, which is causing the trouble; this should be found and rectified; for instance, a lamp may work perfectly on the test rack, but, after being in use for a short time, would have to be changed for dropping. If from the records of that lamp this is found to be its general complaint, then look for the trouble, if a Brush lamp, in the winding—that is, there may not be the proper resistance of wire on the magnets, or there is too great a difference in resistance between them, which should not be more than one ohm or the result is a side puller.

The resistance of the magnets should be kept as near as possible to eighty-five ohms; never allow more than three ohms variation from that amount.

Binding of the mechanism, large washers, or too high adjustment of the arc, will cause dropping; in hunting for the cause of this trouble in the Brush lamp, I found that, with proper construction, it could be made to work without dash pot or spring, better than the old style with dash pot and spring.

I assume that in a differential magnet there must be a point of equilibrium between the two magnetisms, and that, if the cores were accurately suspended at the center of this point, that any variation of current would affect the core quicker if so suspended than if it were forced to or from that point by a spring; this I have found to be the fact. Then by making the lamps so that the core could be adjusted to or from the center of magnetism and get the proper separation of the carbons at that point, would effectually prevent dropping of the carbon rods; and after a Brush lamp is once adjusted in this manner, it will not get out of adjustment until the washers are worn too large. This can be done without glycerine being used in the rods, which is a great source of trouble.

Another point wherein expense is saved in the Brush lamp is in the winding of the cut-out magnet. Divide the magnet in two parts by an extra fiber head, and then by winding the fine wire at the top, with a resistance of fifteen ohms, and the coarse wire can then be wound on at the bottom, allowing the end to make connection with the cut-out armature at least one-half an inch from the head of the magnet; this will reduce the chances of burning out. If there is a bad contact when the lamp cuts out, even if it does burn out, only one wire will have to be removed. If the following rules are strictly adhered to in the putting together of a Brush lamp, it will be found to burn correctly with but little adjusting:

See that the device carrying the lower carbon holder is parallel with the side rods; also that the screws, etc., at its base work freely, and allow it sufficient lateral motion in all directions to affect the adjustment for which this device is provided.

See that the lower carbon holder is in line with its support, or the carbons will not center.

See that the brass tube carrying the upper carbon holder is straight, smooth, and free from small or flat places, and that it moves freely in its bushings, which should not be too loose, as this will allow the carbon too much lateral motion, and liable to slip past or wedge.

See that the upper carbon holder is in line with the rod.

This last adjustment is very important, and is made by clamping a steel rod of the same size as the carbons to be used in the holder, and revolving it between the thumb and the finger, noting whether the lower end of the testing rod revolves on its own axis or "wabbles;" in the latter case, push the holder up to the lamp box, and, by means of the testing rod, bend it slightly in the proper direction to correct the error, then see that the carbon holder has not become loosened; test again, repeating the process until the desired adjustment is reached.

Examine the lifting washers which surround the carbon rod, see that the hole is counter sunk on each side, so as to make the available thickness of the washer where it touches the rod but little more than a sixteenth of an inch. See that the hole in the washer is of such a size that one side of the washer may be raised one-sixteenth of an inch from the horizontal floor on which it rests, before it clamps and commences to lift the rod. See that the holes in the washer and bushings are nicely polished. The lifting finger, designed to lift the washer, should move freely in its guide and get a good hold under the edge of the washer, and allow the latter to rest flat on the floor under it when the finger is down. In the case of double lamps, the lifting finger should be so adjusted as to lift the second rod one-sixteenth of an inch ahead of the first.

See that the movable brass parts connecting the lifting finger with the movable magnet cores work freely at their joints, so that no binding of the parts may be possible.

The spring which partly supports the magnet cores should be made of steel "pianoforte wire," twenty-seven-thousandths of an inch in diameter, wound closely over a mandrel of such size, that the spring when released shall have an external diameter of seven-sixteenths of an inch, and shall consist of about thirty-eight turns of wire exclusive of the hooks at the ends.

See that all the parts of the dash pot are free and do not bind. See that the armature of the cut-out moves freely on its pivot, and when it is down its end is about one-quarter of an inch from the core of the cut-out magnet, and when it is raised and makes contact with the copper wire projecting from the cut-out magnet, that its end comes about three-thirty-seconds of an inch from the cut-out magnet core.

The brass spiral leading from the cut-out armature is not used as a spring, but as a resistance. It must be pulled out or pushed together as the case may require, that it shall exert neither a lifting nor depressing influence on the armature.

This spiral is made of brass wire twenty-nine-thousandths of an inch in diameter and about thirty inches long before being coiled. The size of this wire is important as it should be of just right resistance, that the lamps may cut in when the carbons come together; for this same reason the armature is not allowed to come close to the core of the magnet, but should be made to come as close as possible that a better contact may be made, thus reducing the liability of burning out.

The principal improvements that can be made in the Thomson-Houston lamp are the making of the clutch of German silver or some more durable metal than brass, as the bearing point of the clutch against the rod is so small that it very soon wears and thus throws the lamp out of adjustment. When one of these lamps is found dropping, it can very often be remedied by lowering the adjusting nut No. 692 a trifle, when the lamp will again burn correctly, and, in some cases, this may be repeated several times without any other change in the lamp.

Another great point of improvement in this lamp is increasing the thickness of the insulations, which are too small in nearly every case; especially is this the case with those under the binding hooks at the top of the lamp box, which I find work excellently well when made of porcelain.

When the insulator in part No. 701 gives out, the current shunts through the cut-out magnet, causing what the men term "cut-out armature magnetized." This is a very important point which produces flaming and dropping.

The general causes of the Thomson-Houston lamps dropping are numerous, but if all the working points move freely and without lost motion, it will reduce the number to the few following points: Badly worn spots in the carbon rods; this is a common fault of all arc lamps. The clutch or lifting springs may have lost their temper; these should be made of bright instead of black steel. Clutch arm bent. Clutch or carbon rod bushings may become worn. The adjustment nut No. 692 may be too high, the clutch or tension spring may be too tight. Crooked frames, bent rods or rods striking the chimney, tight bushings, fine wire broken, dirty rods, or the adjustment nut No. 692 being too low; brush in the bushing may be too tight or become corroded or burned, and the magnetizing of the armature before spoken of will cause the lamp to flame and drop.

With the United States or Weston lamp the principal cause of trouble is the tripping from first to second set, and when this happens so that the second set burns first, it generally means a new set of contact springs and new magnet if the lamp burns entirely out of carbons; some of the causes for tripping are, rod sticks or wants new contact brush, lever hook loose, rod scrapes chimney on first set or too much hook on first set, adjusting screw on long hook set too high, lost motion in rocker shaft.

Causes of long arc are, platinum collar dirty or worn out, trip lever sticking or too loose, carbons not burning in proper proportion, burning holder before the carbon rod is down far enough to make contact with trip, small hook dirty, rod crooked near the top, weak magnet, fine wire burnt, clutch holder or armature sticks, rod a little thick at the top and brush too tight.

Causes for dropping out are, weak magnet either fine or coarse, lost motion in rocker, stiff clutch, too much clutch, not enough clutch, slight nigger in coarse wire, plunger too stiff or too loose, plunger bent, broken or crooked plunger rod, bad carbons, which may on starting become soldered together and cannot lift.

The globe holder or carbon holder of the arc lamp is a very much neglected part—that is, the insulations are not made heavy enough, but that the carbon dust or copper droppings falling over the insulations will give sufficient leak that a person standing on the ground and touching the bottom of the lamp may receive a very bad shock, this insulation should be made heavy and so placed that the carbon dust may not fall on it, as it is sometimes impossible to hang lamps under awnings high enough but that, when a person passes under them, they may be touched by any conductor which they may have in their hands. No part of the lamp outside of the globe should be allowed to have current in it. Arc lamps should be suspended by some perfect insulator, the regulator porcelain insulator and hook being the best in our experience; this is a very important point and is often neglected. Lamps being hung from an ordinary screw eye by a piece of wire are frequently seen, when it is as important that the lamp should be as well insulated as the balance of the circuit. Dirt must not be allowed to accumulate on any part of the lamp; rods, switches, bases and globes should be kept well cleaned, and all binding screws kept tight; the rods should be kept thoroughly well wiped every day with a clean cloth or waste. Never allow crocus or emery to be used, as it badly wears the rods in the center. A better plan is if the rods become rough or dirty bring the lamp in and polish on the buffing-wheel, which will allow of its being kept of an even size its entire length. A properly tended lamp will need but little adjusting, but when it is required a regular appointed man should attend to it, or the lamp returned to the station for repairs.

The longest record for any one lamp in a constant street service is three years and nine months without any adjustment other than the ordinary cleaning by the trimmer.

In order to get a good lamp record, no lamp should leave the test rack until it is perfect in all parts.

The most vexatious part of the arc lamp is the globe; it swells the item of expense in spite of the utmost care, besides being a great source of complaint, for I never knew one to be well enough cleaned but there would be a complaint that it was not polished. The fused copper dropping and burning onto the glass makes them look dirty in spite of the best cleaning.

I have found, after a careful experiment, that it pays to put wire nets, which should be made of copper on all globes, even for street lighting; having them covered with wire nets, prevents pieces from falling out even after they are badly cracked, and if the globe entirely gives way, the net will prevent its falling on some one's head.

Undue heat after the carbon has burned close to the holder, is one of the greatest causes for broken globes. This can be partially overcome by leaving the globe about one and one-half inches from the carbon holder.

In looking over the reports of former meetings of this convention, it is easy to see that nearly all of the discussions have been on how to save coal. Of course, this is a point where large money may be saved by use of proper boilers and settings, but the best of these will do no good without proper firing.

There are many other points in the management of an electric light station which are just as important; the most serious of these is the pay roll, as two men more than is necessary will cost nearly as much as a ton of coal per day, and thirty tons of coal per month would be quite a saving, and yet while keeping the number of men as low as possible, none but first-class men should be employed, that all work may be done in a first-class, substantial manner. Especially must trimmers attend to their duty well, as the quality of their work dictates the amount of rebates to be allowed during the month. Another important man in this respect is the dynamo-man. He should give the dynamos the most assiduous attention, that the strength of the current may be kept constant, while flashings and interruptions of the current may be reduced to a minimum, for no matter how well every other department of a station is carried on, if the current is allowed to vary from the standard, complaints will follow, and they are expensive.

There is nothing that angers a user of electric lights so much as to have them flash; it may be only one or two seconds that they are out, but it always seems like a much longer time, especially if in a crowded hall. Rather have the record for continuity of lights so good that even the gas fixtures may be removed; this can only be gained by close attention to the machines, wires and lamps.

I call to mind one place that we have lighted continuously, without any other method of illumination than arc lamps, for over eight years, and during that time the lights have never been out during lighting hours.

The waste in the use of carbons is a very important feature. These should be dealt out and every stump returned; the amount saved in laying by the four and five inch stumps to be used in the summer months will make a saving of at least ten thousand carbons per year for a one thousand light station.

At the time I first started dealing out carbons and bringing in stumps, I saved on an average over thirty dollars per month, and then only trimming about four hundred lamps per day.

A very important feature of arc light stations is the inside wiring and line construction which is very much neglected; all inside wiring should be of best quality of insulation, and run on glass or porcelain throughout their whole length.

An arc light wire should never be concealed.

The use of soft rubber tubing for passing through floors, ceilings, walls, etc, should never be allowed; the only suitable material for such work is hard rubber tubing.

While I am a great believer in the use of the best quality of insulation, for line construction, yet it is not best to depend entirely on such insulation for safety.

Put up the best wire there is, and then apply a rigid system of inspection and tests, not by that abomination of tests, the magneto bell. Not only should the tests be made on dead lines, but should be made at least once in two hours on all live wires, and when grounds or bad leaks are discovered, they should be immediately cleared, by that means preventing the second ground, which is the element of danger.

I have repeatedly had lines that would test clear at the time of putting on circuits, but two hours after, solid grounds have been discovered, located, and found to be wires broken down, hanging over the electric light wires and reaching down to the sidewalk, where they are a source of danger to every passer by; besides every boy that passes must feel of it to see if there is any electricity in it.

My orders are to drop all work that is not absolutely necessary to clear grounds.

In Philadelphia we receive great help from the Electrical Bureau of the city, by their promptly reporting all wires discovered that are down on us.

All lines should be cut by one man, who is especially instructed and detailed for that work, as then you are enabled to pick out a thoroughly reliable man and drill him in the work that he is to do, then, by never allowing a circuit to be opened, and teaching all men to never depend on any insulation, but to treat all wires and lamps as if they were charged with an electric light

current, danger to employes will be reduced to a minimum.

DISCUSSION.

Supplementing the paper, Mr. Law said: In presenting this paper, I have done so with a view to benefiting if possible, the central station men. You will find in the paper a few rules for the operation of the Brush, Thomson-Houston and Weston arc lamps, which have come directly under my personal supervision. If these rules are strictly followed out in the repairing of lamps, you will find but little trouble, and but little necessity of putting them on the the testing-rack. Another point to which I would like to call your special attention is in the matter of testing arc light lines. It has only been within the last six or eight months that we have been putting a thorough test to line wires. Since the time of the Niagara convention we have perfected the system which I specified at that time. I can now positively locate a ground at the station before leaving to hunt it up. These tests are made at regular intervals of about two hours during the night and day on all live circuits. As soon as those grounds are discovered my foreman is notified and I also receive notice myself, and the proper men are detailed to remove them as soon as possible.

In the absence of E. F. Peck of Frooklyn, N. Y., his paper on "Carbon Tests" was read by Colonel C. M. Ransom of Boston.

Carbon Tests.

BY E. F. PECK.

The first electric light of any consequence was used by Sir Humphrey Davy in 1810. He had discovered that when the two terminals of a charged electric circuit were separated a short distance, an electric spark would pass between these terminals by evaporizing the material of which the electrodes were composed, and that the vapor thus produced would continue to carry the current between the electrodes, and that these vapors, together with the highly incandescent solid ends of the electrodes would emit a powerful light. The vaporized material bridging the space between the terminals of the electric circuit he denominated the electric arc for the reason that these vapors would pass in a curved path between the two electrodes. Sir Humphrey Davy demonstrated this interesting phenomenon by using a great variety of material for the electrodes, and he found that the most brilliant effects were produced when the electrodes were made of carbons. The carbon used by him was charcoal made from various woods. It was found, however, that the charcoal from whatever wood it was made always had a considerable electrical resistance, and was so rapidly consumed that it could not be used for the production of arc lights for practical purposes, such as general illumination. Other electricians took hold of Sir Humphrey Davy's discovery and their efforts were directed toward the discovery of material for the production of electrodes of greater durability and better conductivity. It was finally discovered that carbon deposited in the neck of gas retorts possessed a high degree of conductivity, and was exceedingly hard, and therefore would be very durable when used as electrodes for arc lights. Rods or pencils of this gas retort carbon were made and shaped at great expense and trouble, and they were found to be excellent substitutes for the charcoal electrodes, still these gas retort carbons could never be used on a large scale for the reason that they could be shaped to the required form only at a very great expense, being exceedingly hard. The next step in the improvement of carbon electrodes for arc lamps was made in 1842, when Bunsen invented what he called the "Plastic" carbon as the negative electrode of his battery. This carbon electrode was made of various mixtures of powdered charcoal, molasses, sugar, etc. It could be shaped to any desired form, and was made by Bunsen in the shape of hollow cylinders and flat plates. When it was found that this carbon electrode could be used to advantage for the production of electric arc lights, it was at once substituted for the gas carbon. This substitution was not a universal one, for as late as 1873 and 1874, Professor Tindall was in the habit of using gas retort carbons in the production of electric arc lights, although he complained bitterly to his audiences that the production of his carbon electrodes involved great expense and trouble. The carbons burned at the Centennial Exposition in 1876 were of this material, but we have no data of their life or resistance. They were made by Carrè, of France, and the current was from a Gramme machine. From 1843, when Bunsen invented his "Plastic" or moulded carbon, to 1879, many inventors of this country and Europe tried to improve on his discovery. Their chief object was to produce a carbon of greater and more uniform density and of higher conductivity. The English patents were especially numerous during this period, and their mixture in the more enlightened state of the art seems very ludicrous. Though some labored at the problem nearly fifteen years, on the whole no great improvement was made. This poverty of result was largely due to the fact that the dynamo apparatus of the day was unknown. All arc lights were produced by currents generated by batteries. The modern arc lamp, with its simple but effective mechanism, was unknown. The arc light was only a curious laboratory plaything generated expensively, and burned disadvantageously. The proper experimental condition to enable an inventor to produce good carbons did not exist, and the financial stimulus of commercial demands was wholly absent. The modern arc light carbon of commerce is hardly ten years old. It became a necessity as soon as the modern dynamo apparatus was completed and commercial lighting by electricity was seen to be coming in the near future. The problem may be said to have been undertaken in 1878. The first point was to discover crude carbon that was both pure and cheap. At the suggestion of Fayette Brown, of Cleveland, Ohio, his son, A. E. Brown, then experimenting for the Brush Electric company, tried residue from petroleum. Careful experiment proved this to be the long-sought-for crude material, nor have the investigations of the past ten years found any better. The next point was to manufacture carbons of the requisite quality. Nearly three years later the Brush carbon was produced. The first cost of these was very high and the demand small. Where carbons are now sold by the hundred thousand they were then sold by the dozen. Like most new articles the process of manufacture was round-about and tedious, consequently both the cost and market price of carbons ten years ago was very high, the first carbons selling as high as $125 per 1,000. I cannot learn that any tests were made of these carbons for resistance, brilliancy or even exact life. In those days manufacturers were well satisfied if they could make carbons that would burn fairly well, and gave other considerations very little thought, because they were relatively very unimportant. Besides Mr. Brush and his associates, there were several others in different parts of the country working at the carbon business on different lines. At Ansonia, Conn., the Messrs. Wallace were experimenting with forced carbons, with much success, following the process of Carrè of France. This carbon was very dense and hard, and when sounded gave forth a ring almost like a bell. Not to mention many others, Mr. Thompson, of Newark, N. J., was also in the field, but clinging to gas retort carbons for his crude material, did not meet with the success achieved by his competitors. Since those early days of experimental work, manufacturers have paid special attention to reducing the cost, lowering the resistance, and increasing the brilliancy and life of the carbon. Early in the spring of 1889, at the suggestion of a representative of one of the large carbon manufacturers, I decided to base a year's contract for carbons on the comparative test of the best known carbons in the market. I made two or three tests, taking into consideration simply the life and resistance of the carbons as adapted to the system of lighting we were using. The tests were rather crude and not made for the purpose of booming any particular carbon, but to satisfy myself as to what carbon I could best afford to burn. The final test was made with a group of Thomson-Houston lamps on a six and one-half ampere circuit. Two sets of carbons of each make were placed in the lamps and each lamp adjusted to the lowest point at which a quiet arc could be maintained. A record was made of the time of starting each lamp and they were then allowed to burn until all the lamps had cut themselves out automatically, by the burning out of the carbons. The electromotive force at the terminals of each lamp was then recorded at intervals of half an hour through the day. The result of the test stated briefly, was as follows:

Lamps.	1 and 2.	3 and 4.	5 and 6.	7 and 8.	9 and 10.	11 and 12.
Average e. m. f.	42.23.	42.73.	47.16.	43.37.	47.76.	49.66.
Average inches burned per hour.	1.23.	1.46.	1.44.	1 57.	1.72.	1.69.

As will be seen by this table, there was a difference of 7.43 volts or a saving of about 15 per cent. in the e. m. f. of the best over the poorest carbon tested, and a difference in life of .49 inchs per hour or a saving of 29 per cent. In a station burning a thousand arc lamps this means a saving of 64.73 electrical horse power without considering the saving in carbons. The figures given above show very plainly the importance of such tests, and I would recommend that superintendents and managers of central lighting stations give this matter their consideration before adopting any special make of carbons.

DISCUSSION.

Mr. Francisco: If it is not a secret of the business, I would like to ask Mr. Law with what instrument he tests grounds at the stations.

Mr. Law: I do not know that there is anything about our station that we call private. The manner in which I have been testing grounds at our station for the past year or eighteen months, is by the use of a set of incandescent lamps in series; that is, I use 47-volt lamps for a 60-light machine; these lamps are put up out of the way and a wire run from each one of these lamps to the switch plate. There is a lever arranged to turn around in a circle making a short circuit of one, two, three, four, five, etc., to cut out one or all of these lamps. Now, if a wire drops down on an electric wire grounding it, the distance which that wire is away from the station is simply a measure of potentials. Every two hours we test each one of our circuits in the first place by testing across the circuit. The number of incandescent lamps then burning up to 48 volts indicates the number of lamps that are actually burning on the circuit, less the resistance of line, which I find amounts to about ten miles of number 4 wire for every arc lamp; then we test by placing one side of the incandescent circuit to ground and the other side to line; then by turning off my incandescent lights until I bring the voltage up to 47, I find a certain number of lamps burning. We will say ten lamps on the positive side; now I turn my attention to the negative side and go through the same operation. If I find that I have fifty lamps on the negative side, I know that the ground is ten arc lamps away from the station on the positive side, and if your circuit books and diagram books are correctly kept, you can tell in two or three moments' time exactly the location of that lamp. In 99 times out of 100 we go to the right lamp.

J. E. Lockwood: I think this is a subject that deserves a great deal of attention. I think more would be done to prevent damage to electrical interests by false representations of the press by giving them no foundation for any report than by any other means that we have at our disposal. While I think the Law system is a very good one, I think we have now at command one which is much better.

Mr De Camp: I would like to ask a question. In Mr. Peck's paper he speaks of an arc lamp being burned at the Centennial in 1876. I will ask if any gentleman present saw that light? I was at the Centennial probably a hundred times, and never saw it.

Secy. Garratt: I did not see the lamp at the Centennial but as a matter of early history in regard to the arc light industry in this country, I did see an arc lamp run in Boston in 1865; that, however, was not to be called commercial in the sense in which you use it to-day. It was an arc lamp with clockwork feed.

Mr. Lockwood: While I did not see any lamp at the Centennial, I will state that Frank B. Rae of Detroit, will give the gentleman the information he wants. My reason for thinking so, is that Mr. Rae gave me not long ago an account of an interesting experiment he made at the Centennial. He found that by making a flat helix of fine wire and connecting it with the receiver of a telephone, that he could approach a dynamo and before he got within, say five or six feet, and sometimes fifteen or twenty, by holding it out ahead of him, and moving it through the air, he would get induction and then by comparing that with the tones of a flute that he had attuned to respond to a certain number of vibrations, he could tell the number of revolutions the dynamo was making by multiplying by the commutator sections.

F. S. Terry of Chicago: I will say that I saw that lamp in Philadelphia.

President Weeks: The next order of business is "How Our Paths may be made Paths of Peace," by Mr. Pope of New York. This paper has been distributed to the members of the convention, and having been read by title, is now before you for discussion.

The paper of Mr. Pope is as follows:

How our Paths May be Made Paths of Peace.

BY H. W. POPE.

Previous to the introduction of the telephone, the standard of out-door or pole line construction may be said to have been that established by the Western Union Telegraph company, or organizations that from time to time came under its control by purchase or consolidation. The lines of these companies were never of a superior character, nor in any way comparable at the time with those erected in European countries, and it was not until after thorough inspection and exhaustive tests were made by a prominent English electrician, employed for the purpose, that extensive alterations and improvements were made, greatly increasing the efficiency of the wires, and, naturally, their more economical operation.

The construction of a most excellent line along the route of the Pennsylvania railroad, between Jersey City and Philadelphia, by the management of the American Union Telegraph company, previous to the absorption of that company, marked a new era in line construction, but, notwithstanding the brain that inaugurated this departure afterward controlled the great competing company, the standard thus established was never closely followed by them.

However parsimonious the Western Union company may have been in their construction and maintenance expenditures, telephone, electric light and similar corporations would have been greatly enriched by literally following in their footsteps. They encouraged and provided for increased conductivity and tensile strength and fair insulation, and established a department of competent and reputable electricians and experts, to insure a systematic compliance with specifications and requirements, destroying the evil that had grown into prominence, which permitted officials to exploit hobbies of their own to the detriment of the business and the ridicule of electricians. To those of us who have been identified with electrical interests for the last quarter of a century, there seems to have been no notable improvement in line construction, except as shown in the recent interstate lines of the American Telephone & Telegraph company. The introduction of the telephone brought into the electrical field a very large class of workers devoid of electrical knowledge or experience. To this class, the methods employed and the standard of construction prevalent, were superior to the necessity and requirements of the telephone. This opinion and the lack of sufficient capital to properly exploit the telephone business was primarily the cause of the introduction of poor material and workmanship, as well as the small wire and insulators, together with porcelain knobs and cheap insulation.

With the experience of our predecessors in the electrical field, and with the knowledge of the character of the current we were handling, it would seem as if a superior character of construction and insulation would have been deemed imperative; yet, with the exception, perhaps, of conductivity, everything in connection with the conducting of the current was inferior to that previously used by corporations employing harmless voltage. That such was the case is due somewhat to causes similar to the introduction of the telephone—but the use of cheap insulation, what is popularly and properly known as "undertakers'" wire—was due wholly to the ignorance and stupidity of underwriter officials, to whom many of us protested repeatedly against its use.

The accumulation of poles, the inferior character of the materials used, and the utter disregard of public considerations or the character and beauty of the surroundings, gradually molded public opinion against poles and wires in general, and electric lighting in particular.

The desire of electrical manufacturers to crush their competitors, was accelerated by distressing accidents, until every publication throughout the land magnified the dangers of electricity, depreciated our property, and retarded the progress of electric lighting and electric propul-

sion beyond our comprehension. To this condition of things we must now devote our attention—adverse legislation is cropping out in nearly every state in the Union, tending to regulate voltage—to bury the wires, and to accomplish other reforms too numerous to mention. In view of all this, it should be the aim of electric lighting corporations to so reform the existing methods of construction as to show a decent regard for public opinion as to safety and the appearance of their structures in the public thoroughfares. By a sincere effort in this respect, beneficial improvements can be introduced without necessitating large expenditures, and the clamor for the removal of overhead wires reduced to a minimum. Where there happens to be an unnecessary aggregation of poles, endeavor to perfect an arrangement whereby poles may be occupied in unison, and as many poles removed as circumstances will admit. Such a course will reduce your maintenance expenses, and create for you favorable public opinion. In the erection of poles, considerable attention should be devoted to their design and proportions, and the character of finish, to the end that the structure may be made pleasing to the eye. The removal of a pole because of deterioration, or with a view to the erection of another with greater capacity, should be followed by the substitution of one in every respect superior in strength, design and finish. The question of expense, as compared with common poles, should not be allowed to deter you from the ultimate purpose of replacing your entire line, especially in cities or towns where the burial of wires would be a financial impossibility.

To those familiar with the recent excellent structures of the Long Distance Telephone company, or those of some of the electric railways, the possibility of improving upon the present methods of construction will readily suggest itself. While it is not advisable to use iron poles, combination of wood and iron can be used to advantage in many instances. The practice of introducing wires into the front of buildings is an objectionable method and should be discouraged when possible. This can often be obviated, as well as hundreds of other similar disreputable and unsightly practices, if given a little personal attention and consideration by the general manager.

It will be frequently discovered upon investigation, that lines of poles erected in the streets in front of buildings can be removed to an alley or street in the rear, or constructed over private rights of way by the payment of a nominal consideration Where such a condition of things is possible, it will be found desirable and preferable to incur the expense and make the change voluntarily.

Reduce, rather than augment, the number of poles which at the best cannot be else than unsightly. Provide every pole with iron steps and paint the poles as thoroughly as you would a house, and select colors that will not make your poles more conspicuous than they really are.

In so far as a neat, well-designed and substantial brick station reduces your rate of insurance, gives character and substantiability to your investment, so will the improvements suggested—however small and insignificant at first—if properly and sincerely carried out, win for you favorable consideration and fair treatment and enhance materially the value of your property, besides tending to postpone indefinitely the removal of overhead wires.

It should be the aim and policy of all electrical corporations to constantly improve the condition of poles and lines—giving as much attention to their strength and beauty as to their perfection electrically. The assumption that such a course is unwise, because of the theory that sooner or later all wires must be buried, is wrong, because it is questionable whether such an extreme will be reached, especially in cities and towns of small population.

Every day that you delay these improvements you encourage adverse criticism and hasten adverse legislation, state and municipal.

Subways and underground structures are not pleasant things for the strongest of us to contemplate, and where, heretofore, you have had only the gas interest to advocate these measures, you now have competitors in the electric light business, urging legislation against overhead wires with the same earnestness as inventors and manufacturers of cables and subway appliances. These interests are better equipped with facts and figures than has been the case heretofore.

A policy such as outlined, and a vigorous state organization of electric lighting companies, will protect our interests from any severe measures at the hands of the general public.

PRESIDENT WEEKS: The next order of business will be a paper by Professor Elihu Thomson on "Safety and Safety Devices in Electric Installations." The paper has been distributed to the delegates.

The paper of Professor Thomson was as follows:

SAFETY AND SAFETY DEVICES IN ELECTRIC INSTALLATIONS.

BY PROF. ELIHU THOMSON.

The development of the electrical arts, particularly in the direction of lighting and motive power transmission, has, in the past few years, been very great. It has brought with it a demand for very much work of a novel character, as regards the details of plant and methods of installation. It has also entailed, in many cases, elements of risk to life, and danger of fire. How far these risks have been or can be removed by proper attention to details and care in installation, has become an important subject for discussion. How far such risks have been increased by reckless installation of conductors, by faulty materials and supervision, it is not easy to determine. There can be no doubt, however, that electricity, as an agent, in itself is not to be charged with bringing about the results for which recklessness in its use is sufficient to account. That under favorable conditions for discharge through a person's body, electric currents of comparatively high pressure may injure or kill, is not to be questioned for a moment. I have no sympathy with any effort tending to impress a false estimate of such risks, or tending to give the impression that they are absent, when in reality they are existent. I have no sympathy with any effort to exaggerate such risks, efforts which have not been wanting, indeed, as is well known. The fire risk, as well as the personal risk, involved in electric work is present in a greater or less degree, in accordance with the perfection of the work of installation and maintenance, the provision of the proper safeguards, and selection of the best conditions.

These are matters which are, every day, of growing importance in all the electric industries, not even excepting telephonic systems and other such work, which, if badly arranged and not properly maintained, may cause crosses due to falling wires, etc., to become sources of danger, trouble and annoyance in the distribution of lighting or other currents. There is one fact which is of the greatest importance in this connection, and it is that safe installation means, also, good service. There can be no question that the risk to life from shocks, even with bad work, would be removed by not using high potential currents, as they are called, either alternating or direct. There can be no question, also, that a shock obtained from certain characters of current, such as alternating current, is much less safe than in the case of continuous currents of equivalent pressures. Nevertheless, I am just as firmly convinced that the fire risk is very much less with alternating than with continuous currents of equivalent potential, assuming the work of installation equally good. The fact that it is difficult to sustain an arc, or rather that it is easy to select conditions which will prevent arcs forming with the alternating system, as compared with the continuous current systems of much less potential, is greatly in favor of the former. Hence switches, fuses, bad joints, ruptured wires, are much less liable to arc and incur risk of fire with alternating than with continuous currents. Would it be possible to work successfully, using only low potential currents of either character? Would we be able to utilize water powers for lighting, without employing pressure of potential sufficient to convey the energy to a distance over a conductor of moderate or non-prohibitive cost? In most cases we would certainly not be so able. Again, to utilize water frontage for cheap coal supply, and to employ compound condensing engines, to insure small running expenses by massing the machinery at one station, to make use of railroad facilities, etc., in short, to work under the most advantageous operative and economical conditions, we must convey electrical energy by moderately high electric pressures, so as to avoid prohibitive losses or prohibitive cost of conducting wires. If ever our great natural resources in water powers are to be developed and utilized it will be by the employment of comparatively great electrical pressures for conveyance of energy to distant points. If great saving of cost of fuel and other expenses in operating one large steam plant, instead of a number of separate plants, with their attendant risks, in large cities, is an object worth seeking, it will be found in the conveyance of electric energy at fairly high pressures. It must not be forgotten in this connection that even with very low pressure currents, safety from fire risk is only to be secured by careful construction and supervision, and that risk of fire often involves personal risk. Subway and underground conductors have caused manhole explosions, with both low and high potential currents. Such accidents are generally explained by accumulations of coal gas formed in the manhole and subsequently fired by the electric arc or spark of a leak. This may be and probably is sufficient explanation, but another may be given—the evidence of the possible correctness of which I have witnessed. A heavy leak or overheating occurring at some point of the conductors near the manhole may generate directly a large volume of inflammable gas from the distillation of asphaltum or other substance used as an insulator, and this gas, mixing with the air of the manhole, may be easily fired by the heat of an arc or spark subsequent to its production, and cause a violent explosion. The remedy is thorough and continuous ventilation of the spaces in the manhole and subway. An instances of a storage battery car being wrecked, from a similar cause, is on record. In this case the battery conductors were probably overheated by a short circuit and filled the compartment in which the batteries were with inflammable gases, and the further heating fired the mixture, the result being a violent explosion which greatly damaged the car. Such accidents always involve personal risks, and are to be prevented by simple means properly applied.

But the popular mind is so used to gas explosions that the newspapers have only a few lines to devote to them, while an accident in which an electric shock is obtained, although it has taken place through disregard of some simple precaution, is more than likely to be copiously provided with head lines and harrowing details. I even find one of the journals, whose name states its scientific character, attributing both the Lynn and Boston fires to electric wires. There is on exhibition at Lynn as a curiosity, the oil stove which caused the fire, and inquiry into the cause of the Boston fire has, so far as I can learn, rather tended to discredit the theory than to confirm it. Notwithstanding these facts it is true that under faulty conditions of lines or plant, fires may arise, and hitherto have arisen, traceable directly to the heating effects of electric currents. Perhaps if the accidents which happen serve to enforce the fact that the best work, the most thorough provision for emergencies, and careful consideration of details of electric work will be requisite to secure proper safety in the electrical field as in other classes of work, their mission will be fulfilled. Severe and inconsiderate as has been the dealing with the wire question by the authorities in New York city, yet it cannot be denied that the condition of the overhead circuits there had been in the past few years going from very bad to much worse. In many cases considerations of safe working would seem to have been neglected in the competition for business. The lines of four or five different companies competing in the same territory might be found, the result of this condition being, without doubt, to enormously increase the risks. There have been hints of the coupling up of dynamos in series, and so increasing the potential of lines already worked at two high pressures in relation to their condition of insulation, and to the placing of the lamps or other work supplied from such lines. Along with this we find the air full of telephone, telegraph and signal wires, of various sorts, none too secure from rusting out or breaking. Many of these latter wires could, no doubt, be easily buried underground, with advantage to the service, but it is certain that to attempt to bury the electric light wires in a hasty, ill-considered fashion, merely for the sake of getting rid of overhead lines, would be productive of no good results, either in avoiding risks or bettering the service. The placing underground of very many of the wires now found overhead in our large cities is, in my opinion, a matter which must come in time, but it should be done carefully and gradually, so as to secure the best work. Meanwhile, the reorganization of existing wires, the removal of unused wires or redundant wires, as where two systems or circuits in the same territory overlap while serving substantially the same purpose of supply and the use of first-class insulation on the wires would go far to securing safe working and uniformly good service. Besides all these precautions, and outside of them; whenever the conditions are and have been favorable to safe installation of overhead or underground circuits, there are to be found a class of appliances which are called "Safety Devices," inasmuch as it is their purpose to provide for abnormal conditions and to remove risks which, with perfect working and maintenance, are usually absent, but may be brought into existence by accident or unforeseen defects. Such risks may be by outside interference with lines, or by lightning, by falling or poorly constructed signal and other wires upon overhead wires, by unusual wind or sleet storms, by failures of all kinds, as in the working of lamps, switches, etc. It is here that the safety device is found to be useful. Such devices are to the electrical systems what check valves, overflows, traps and safety valves, are to hydraulic systems. There is, of course, no room for doubt that if the insulation of all parts of the plant, as dynamos, lines, lamps, etc., were maintained always at its best, and if the mechanical strength of lines, hangers, poles, etc., could be always relied upon, and further, if the effects of lightning induction were never present, there would be but little use for any purely electrical safety appliances, such as those for guarding against leaks and diversions of current. To expect such perfection of conditions is to expect too much. A rigid system of frequent testing can, however, go far to anticipate and to discover the departures from such safe conditions, and enable the disturbing conditions to be removed. Nevertheless, there will always remain opportunity for unskilled or careless handling, so altering the condition as to provoke trouble; there will always remain chances of undiscovered defects, chances of interference from outside. The effects of lightning are an important factor during the thunderstorm season. I am driven to conclude, therefore, that safety devices are, and will continue to be, important factors in electric work. The more thoroughly they are adapted to their intended functions, the greater the security, and the more extended their application. That system of distribution will surely survive, which, while involving economy of first cost and maintenance, at the same time secures the greater safety and embodies the greatest flexibility. I assume, of course, that the running economy is practically good in every case.

In the very early days of arc lighting, with a single lamp only on a circuit, the idea of safety from fire or shock did not present itself. When such lamps began to be run in a series of eight or ten, or more, the need of an efficient cut-out was felt, so that a defective lamp failing to feed its carbons should not burn with a long arc or flame, and so involve risk of fire, or extinguish the other lights. This need was met in 1876, by Lontin, who used the shunt circuit to actuate a shunting switch around the defective lamp. The Brush cut-out followed, and was a decided improvement on Lontin. Fuller and others early went over the same ground. The film cut-out, or shunting switch, depending on a small thickness of a high resistance insulator, such as oiled paper, to prevent its closure, which paper film is overcome by the difference of potential or pressure between the carbons when a long arc forms, was brought out by the writer and later, the "vacuum cut out," a modification which rendered the device self-setting for repeated action if needed. It is scarcely necessary to add that spark-catchers and inclosing globes with wire nettings, were early additions to arc lamps to prevent sparks reaching inflammable material near by, and the globe also in addition served to diffuse the light. Current regulators were additions to arc machines, and acted to prevent undue current, and secure thereby not only safety, but good service. The fact that good service in most cases is assisted by appliances which insure the safety, or is even dependent on them, is a fact which ought not to be lost sight of in connection with the general subject of electric installation.

The early installations for arc light in and out of buildings, were made with bare wire circuits, and it is a satisfaction to me to recall in these days of forgetfulness of the benefits conferred by electric industries, and exaggeration of the dangers of properly installed plants, a case which occurred in connection with one of the earliest commercial plants of the Thomson-Houston arc lights in 1879. The machine of about eight or nine lights' capacity, with bare wire lines, was put up in a large brewery in Philadelphia; two arc lights lighting the stables in which were thirty, or more, valuable

horses. One evening a fire started in the hay-lofts in the story above, and where there were no lights of any kind used, and soon the flame and smoke spread to the stable room and menaced the horses. The proprietor happened to think to start up the electric lights at this juncture. Their brilliant rays saved the animals, which were removed without trouble, and the lights were kept burning during the progress of the fire. Its spread was limited by the efficient work of the fire department. The arc lamp globes were at times full of water, but to the surprise of the firemen, the lights were not extinguished, but assisted them in their efforts very materially.

As the number of arc lights placed in a circuit grew, the necessity for thorough insulation was appreciated; the effort to secure which, for arc lighting lines, has resulted in very great improvements being made in the past few years. So far as electric wires go, the best "safety device" is a perfect insulation. In order that this matter shall not assume the condition of a trial of strength between armor and armor-piercing, as in naval affairs, with a constant growth of both, the advantage always being on the side of armor-piercing or insulation-piercing, I think that efforts to run more than a certain limited number of arc lights in series should be discouraged. Eighty, or one hundred lights, or even more, have been run and could doubtless be run safely under favorable conditions, but I doubt that such conditions can be found in city work; the interfering actions are too numerous, while the maintenance of good conditions would be too expensive. Without such good conditions, there would be grave dangers involved.

It has become a practice to use incandescent lamps of low resistance in series on arc light circuits or other constant current lines and much useful work is so accomplished. Here, again, safety from fire risks depends on certain safety devices, the most important of which is the shunt-forming device, when the carbon lamp conductor breaks. A number of very simple and effective devices are employed for this shunting action. Without such devices the tendency to arcing would be very great. It is advisable also not to rely on any one device alone for this purpose, especially if the lights are used indoors. Here the film cut outs may supplement the action of a shunting device operated by the heat of an arc set up when the lamp carbon becomes discontinuous. These latter are the fusing cut outs, twisted wire cut-outs, and others which connect the lamp wires together in the lamp, and so form a complete shunt. Other forms exist, notably the third wire cut-out, acting by diversion of current from the arc to a third or intermediate wire between the lamp conductors.

As in case of the other devices mentioned, the perfection of operation of one, or a combination of several of these shunting contrivances, conduces not only to uniform service but to absence of risk. Absolute cut-off switches are now in common, if not in universal, use to cut out loops of series circuits, and in a measure may therefore be regarded as safety devices, but not of an automatic character. Outside of these factors just mentioned, safety in such circuits rests in insulation and maintenance, avoidance of leaks, or crosses proper placing of wires and lamps, avoidance of partial contacts or partial ruptures of the current at joints, binding posts or switches. In series circuits, the main object is to avoid a concentration of, or establishment of, large differences of potential at points in the line where the currents find or can find a path; in low potential, multiple arc systems as used in direct incandescent work, the object is to avoid concentration of current at points where such current cannot find a sufficiently low resistance path. Hence there is required cut-offs for current when excessive in any part of the system. Short circuits of accidental character must be provided against. If the safeguards are not ample, a more potent fire producer than a short-circuited section of an extended multiple arc system, is hard to find. Take out your fuse wires and replace them with copper wires, a practice, instances of which were not difficult to find in times past, and a short circuit may quickly heat a long line of wire in a building, so as to set fire to the insulation of the wire and surrounding woodwork. The fusible wire cut out, if properly made and used, is an effective preventive of such risks, though magnetic cut-offs are preferred by some, though more expensive. The magnetic cut-offs, which are simply open-circuiting switches, controlled by magnets in the branch or line so as to open it on excessive current, have the advantages of promptness, avoidance of the scattering about of fused metal, and can be reset without any renewal of material, so differing from the case of a fuse wire. Another risk in such systems is that of creeping of current from main to main over moist surfaces, or partial conductors, in amount insufficient to blow a fuse, but sufficient to convert enough energy into heat to set a fire. Good waterproof insulation of wires avoids this risk if the insulation remains intact. I consider the plan of running the two branch wires, excepting the larger ones of the system, near together or close together, as excellent in avoiding this risk, provided the wires are encased in insulation and covered in, or run in a tube. In case of a leak from main to main, the more quickly the fuses blow the better, and the proximity of the wires assists this speedy action, while between the wires there is not at any time enough combustible matter to set a fire by the short circuit. Inclosure in a tube effectually shuts off possibility of flame reaching combustible matter before the fuse blows. This does not apply to the heavier mains, capable of carrying thousands of amperes, so well as it does to the smaller branches. I am glad to note here that the tube or conduit system appears to be well worked out for inside wiring by the Interior Electrical Conduit company.

Another thing to be avoided in extended systems of multiple arc work is grounding or leakage to ground of current over resisting surfaces or materials. The tube system is useful here as well, and the placing of two wires at difference of potential, near together, assists somewhat, but does not entirely remove liability of grounding. Testing for grounds in the system, taken in sections, is the proper procedure, although this does not provide against all suddenly formed leaks. It may be argued that in this case two grounds are necessary to cause a leak, one on each side of the system, and this is true, but in very extended systems of overhead work, more or less general leak exists which may provide sufficient current to feed, as it were, a local leak to ground from either main.

Let us now deal with what is called the alternating, or induction system of supply, in which the local or house mains, are separate from the primary mains, and of much lower potential. For lighting purposes the system is very flexible, and enables distance to be overcome. The secondary circuit is, or should be, entirely out of connection with the primary mains of high potential, and the potential differences of the secondary circuit may be so low as to be incapable of giving a severe shock under the conditions of use, and to be almost incapable of setting a fire, on account of the absence of arc forming tendencies. This is, indeed, an important factor in alternating current work, and conduces to the perfect working of switches and cut-outs, and the prevention of diversion to ground. Good work is all that is needed in this case to abolish all risk, if we leave out the main high potential current. The local line is unaffected by leaks or grounds at other parts of the system, and is, therefore, in this respect, in a better condition than is found with the consumer's lines in any direct system of supply. On the other hand, all the cases in which persons have received a shock from an alternating current of 1,000 volts or upward, without being killed, are fortunate accidents, for there cannot be the slightest doubt that such current can and will kill under conditions favorable to its passage through the body. There are many cases of severe shocks having been obtained from such currents without permanent injury. On the other hand, there is a sufficient number of fatalities on record to sustain the position taken. The risks with higher than 1,000 volts alternating current are, of course, greater. It must not be forgotten, in this connection, that the actual potential differences in an alternating current of 1,000 volts are higher than that figure, and may be, at every wave, upward of twice as much. This confers on such currents an actual and measurable striking distance between the two mains. As with arc lighting lines, the main or primary wires, if overhead, require to be kept thoroughly insulated and free from leaks to ground. The covering for the wire should be capable of resisting moisture, and the wire used be strong enough to prevent any possible breakage. If the primary wires break and come down, they are still kept charged from the dynamo, which is not always the case with arc light lines. If, however, the insulation is strong and perfectly good, the risk to life is small in such case. There is one fact I wish to impress, however, and it is, that, with a perfectly insulated set of alternating primary mains feeding transformers, there still remains the static capacity of the line or cables and transformers, and this may be of an amount sufficient, if a person is grounded and touching the primary line, uninsulated, to give a severe if not a fatal shock. This inductive shock or discharge is, of course, far more pronounced with ordinary underground conductors than with aerial lines, and increases with the size and number of transformers and the extent of the line. It also increases as the voltage of the primary line is increased. Hence, it is quite important that no leak or connection exist between the primary line and a secondary in such system, or otherwise there may be a transfer of potentials of the primary line to the secondary, so as to involve risk of shock to the consumer, or risk of fire from leaks to ground indoors. It will not do to say that such connections do not often form, for they may form from defects in construction, from moisture, and particularly from lightning discharges. A person standing on a damp floor, leaning on a steam radiator, touching a gas pipe grounded, or in other ways, may, if he handles or touches the secondary line at any part of it, be in peril of severe, if not fatal shock. What was without this condition a most harmless local line, becomes most dangerous.

The writer early recognized this danger, and felt that unless it was provided for, the induction system was not advisable for general use. As a consequence, the expedients of grounding the secondary, or of surrounding the secondary by a grounded sheath, or of cutting off absolutely by automatic means the local line when connected with the main line, or of automatic grounding of the secondary by insulating films or spaces which are punctured or overcome by the potential of the primary when connected with the secondary, were devised as safety devices. The grounding of the secondary is the most simple and effective if good grounds be made. It must, however, be done with certain precautions to insure the best results.

The second expedient of a grounded metallic sheath between the primary and secondary is persistently called "Kent's sheath" when alluded to by our English cousins, despite the fact that it is American in its origin. It is effective as a protector, as it carries to ground any discharge leaving the primary before it reaches the secondary. The sheath is easily made by placing a somewhat open wrapping around either the primary coil or the secondary coil of the transformer made of flat metallic ribbon or insulated wire, the ends of which are grounded when in use. The course taken by the wrapping is around the wire of the coils at right angles to its direction of winding. The automatic absolute cutting off of the connection between the transformer coils is also effective, and has undergone several modifications in other hands. The last protective device mentioned above leaves the secondary insulated from the ground until a contact or leak from the primary takes place, when an automatic ground is made. One of the forms consists in the interposition between the ground and the secondary coil or line of a film cut-off, or thin paper film between two metal buttons pressed together, one button connected with the ground, the other with the transformer secondary. This device is very effective in securing a safety ground connection of the secondary when the primary leaks to it. A well constructed transformer properly installed will not, except by accident, lose its insulation between primary and secondary, and such insulation should always be many times that otherwise requisite, so as to have a margin of safety; but the safety device is none the less a necessity in its use.

I consider that a properly arranged double wire cable, well insulated, constituting the primary line; laid in ventilated pipes underground, transformers connected therewith, also inclosed in a grounded metal case, as in the cellar of a building, a secondary line of low potential grounded, or provided with safety devices as mentioned, embodies as safe a system of incandescent electric light distribution as can be devised, both as to risk to life and danger of fire. It insures complete safety to all the consumers, and to each one individually. It enables long distance work to be undertaken, and allows low voltage lamps to be used with their increased economy. The risks are confined to the electric station and the primary lines which should be handled by men who know their business. The non-commutation of the current at the generators is another advantage, of course. The disturbing influences, which in the best organized plant may be introduced by lightning, are serious and sometimes destructive. It is not that the lines are struck by lightning in causing such trouble, but the mere inductive current or discharge from a flash of lightning is quite sufficient. It puts upon the line potentials of many thousands of volts, and tends to break down insulation everywhere. Lightning arresters are therefore important safety devices in more senses than one. They save the machines in the station and the apparatus outside. In the alternating system they save from puncture the insulation between primary and secondary coils of transformers and between the turns of the primary coil itself. Every plant, then, should, if subject to lightning induction, be provided with efficient lightning arresters or dischargers.

A discussion of this general subject, however brief and necessarily restricted in scope, would be very incomplete without allusion to the subject of contact with telephone or telegraph wires by electric light conductors. Underground and in conduits such contacts could not easily occur, though leak might readily take place between lighting conductors and other wires. In any case, there is a risk of such wires carrying current into buildings or to positions bringing about shocks to persons, thus involving risk of fire or danger to life, or both. As a consequence, a set of safety devices has been brought out under various names whose purpose is to cut off dangerous currents when they reach or traverse lines, such as those of the telephone or telegraph. It is my opinion that in cities the provision of approved devices of this kind should be compulsory. Most of those which I have seen are not well enough designed or made to be perfectly relied upon, but are much better than nothing and may possibly suffice. Such apparatus, however, should be made so as to be perfectly reliable and undergo a regular inspection. Mere fuses, even if made long, are not enough. There should be placed in every circuit liable to contact with lighting or such like conductors and at a place in the circuit where it enters a building, a protective device which, to be complete, should shunt or absolutely cut off the section of wire indoors, or ground the same in case of abnormal current on the wire, or abnormal potential.

There is much more to be said on this subject, and I am conscious of only having touched upon certain important matters in this paper. If I have succeeded in pointing the way to better conditions in any case, I shall be more than satisfied.

To sum up briefly, safety in outside work means care in placing, maintaining, and insulating conductors, whether used overhead or below ground. This means the employment of only good linemen, and not men who are ready to incur risks through a reckless disregard of conditions of failure to comprehend their importance. Men who have done telephone or telegraph line work are not necessarily prepared to undertake electric light and such other work with the best success. Safety in inside work means, primarily if admissible, separation of the inside circuit absolutely from the general supply mains, and in any case it means that good, careful workmanship is requisite, and that the employment of safety devices, amply sufficient to do the work required of them in case of accident, is imperative.

Safety from current entering buildings upon telephone, telegraph and other wires, means first, a more systematic placing of such lines apart from electric mains, whether above ground or below, guard wires and insulated wire for such lines, stronger wire, especially for telephones, and the employment of safety devices in case of accidental leaks or crosses occurring with electric mains, of either low or high potentials, and a periodical inspection by proper officers.

Discussion.

Mr. Lockwood: I am sure that every member of this convention must feel in the present condition of electric lighting the need of safety devices. I hope that by the

time this convention adjourns, we will all get ideas enough regarding all possible means for safety, so that when the next annual convention meets we will have a year's record that will compare with any record that could be asked for. I do not want to be understood that I am now using in my station every device that I advocate, because I am not. But they will all go in there with the greatest possible haste that I can get them in, and do the work thoroughly, and from that period I am going to keep our station in the matter of safety devices at the head of the list as far as lies in my power.

On this question of lightning arresters, it is not so much a question of preventing accidents to the employes and to the public. I do not think it is as necessary as some other devices, but it is one of the simplest and best things that can be provided for safety, with our present knowledge.

Professor Thomson speaks of the advantage of using high potential as a measure of economy in fuel and other expenses. I think that we all agree that the more we can centralize our work, the cheaper we will be able to operate our lamps, and the more carefully can we supervise the work that is being done and maintain everything at the proper standard. He speaks of the fact that the dealing with the wire question by the authorities in New York city has been very severe, but yet thinks it will lead to final benefit to the electrical interests I think the question as to whether that would be so or not, depends upon no one thing more than how we keep our circuits supplied with safety devices from this time forth. I think that doing so will do more to solve that question than anything else. I think if we do not pay great attention to adopting means for denoting a ground when it occurs on a circuit and then locating it and finding how it can be removed in the shortest possible time, and seeing that in all ways they are kept clear and free, we will not have the success that we should have.

Mr. Law: In the matter of lightning arresters, I think we have a very important species of safety devices for central station work. Not only does it protect the dynamos, but it protects the insurance companies against loss by fire. Before the adoption of lightning arresters in our station in Philadelphia, we had three fires in buildings in different sections of the town which were caused by lightning coming in on our lines, but since the introduction of lightning arresters we have lost no dynamos and have had no fires. Another important feature of lightning arresters is their protection to underground cables in taking up the so-called static discharge of the dynamo on the interruption of the circuit. I find it very valuable in that respect. The matter of cut-out boxes is another very important feature. They should be placed on every part of the circuit where it goes inside of a building or is attached to a building or a loop going over any street. It gives you perfect control of that circuit in case of fire. That was clearly demonstrated to me about two months ago at a fire we had in Philadelphia. I was at the fire very soon after the alarm, and found we had a loop going up in the rear of the building. I discovered there was no box upon that pole, for which my foreman received very severe censure. I was obliged to put in a cut-out to cut those wires loose. Had I had a cut-out box there it could have been done much quicker and much more safely.

Captain William Brophy: I wish some one who had better control of the king's English than I, would do justice to the barbarous treatment the electrical fraternity has received at the hands of the so-called underground commission of New York. I agree with Professor Thomson in all he says in regard to that subject. A few men selected without any regard to their qualifications for the positions they hold, sit in judgment and throw a large city in total darkness without making any provision for any other form of light, and as it were, turn the whole city over to the hands of thugs and criminals. I believe myself that the insulation of overhead wires is only a question of dollars and cents saved to the parties who are operating the central station. I do not believe it solves the problem of preventing accidents to life and accidents by fire. An unused wire that no one cares about can drop down and saw its way through in half an hour, and some one will come along and complete the circuit from the wire to the ground and be the victim, and the press sends the news all over the land, giving no explanation of how or why it was done. So far as safety to the public is concerned, if you will run your wires well up in the air, if you can get the right of way to do so, it matters little whether they are bare or insulated; but if you want to carry on a successful business it is your duty to properly insulate your wires. Until the municipalities or some other power will protect you from tramp wire, the poorly constructed wire, and the many other roads through which death and destruction may be carried as they say, you cannot be held responsible for these accidents, and until you have the right and the clear right to run your wires without being menaced by such things as these, you cannot prevent accidents of this kind.

The secretary read the report of the committee on data as follows:

Report of the Committee on Data.

The membership of the committee as now constituted is as follows: A. J. De Camp, C. R. Huntley, E. F. Peck, Edwin R. Weeks, Allen R. Foote. This committee has printed in pamphlet form and distributed to central station companies, the paper read at the tenth semi-annual convention of the association on "The Value of Economic Data to the Electrical Industry." Accompanying this pamphlet, a circular of inquiries was sent, inviting suggestions as to the items of data which those addressed considered desirable to be collected, also the forms of accounts, reports, which may be used to establish a uniform system of accounts with a view of rendering the data obtained from them reliable and valuable.

The responses received, by correspondence and personal interviews, leave no doubts in the minds of the committee as to the general appreciation of the value of the work to be undertaken and of the cordial co-operation of central station companies in carrying it to a successful consummation.

In view of the fact that the United States Census office is now engaged in preparing schedules for obtaining certain data relating to the electrical industry, this committee thinks it best to suspend the work of formulating reports for the purpose of obtaining data until after the work of the census office shall have been officially published. The committee can then devise such reports as may be supplementary to, or a continuation of, the work done by the census office, thus increasing very greatly the value of the work it may do.

With the above object in view the committee has given special attention to the work of assisting the formulation of a special schedule for central station companies for the use of the census office. The outlines of this schedule have been submitted for suggestions to upward of thirty of the largest companies in the country. A representative of each company has gone over the entire subject in detail individually, and made such suggestions as seemed to him to be pertinent. The entire schedule is now in process of revision in the light of these suggestions. When this work is accomplished it will be again reviewed by this committee. In case the schedule as then submitted is satisfactory, this committee requests the authority of the association to approve of the schedule in the name of the association

The first decade of the history of the electrical industry was necessarily the decade of theory and experiment. A decade in which large sums of money have been invested on the basis of representations made by manufacturers as to what their apparatus or construction was expected to do. During this period, the time of the conventions of this association has been largely consumed by long, and sometimes exciting discussions over this or that feature of the business in which all were engaged. No satisfactory solution has been reached by such discussions, because arguments were based on what was expected to be, instead of upon what was.

In entering upon the first year of the second decade of electrical history, it will be well for the association to draw a sharp line of demarkation and cease to discuss subjects from the standpoint of theory It should substitute therefor the standpoint of facts. Not that the days of theory and experiment are over, that will never be. But the days are over when to have an electrical service at all, it must be accepted on faith in promised results. The time has come when we can afford to wait for the adoption of a new idea, or new application of an old idea, until it has been put into practical use for sufficient time to enable their claims for general adoption to be based on accomplished results. Whose cause cannot be served by truth, should not be served.

The report of the committee was adopted, and the committee was continued.

Investigation of Electrical Industry for the Census.

Mr. De Camp presented a resolution, which, after a preamble, read as follows:

First That it respectfully petitions the Senate and House of Representatives of the United States Congress to authorize and direct the superintendent of census to collect the following data in relation to the electrical industry, in addition to the general statistics of manufactures already provided for by law:

(a) Details pertaining to underground and aerial construction, underground and aerial currents, the character and voltage of all currents, and their uses. Lamps in use, arc and candescent, and how wired for residence, commercial and municipal service; motors in use for stationary service and motor cars; income and expenses, etc.

(b) An inquiry through sources independent of those interested in the industry, as to the casualties resulting from the use of electric currents, both as to fire and personal injuries; this investigation to be made in all cities of 10,000 population and over; the information to be obtained from underwriters, the records of fire departments, coroners' statistics, health boards or commissioners, or from whatever source of information that may exist in any city; the investigation to make a comparative statement between the casualties resulting from the use of electric currents, and the use of other agents employed for similar purposes.

Second. That we hereby petition that an appropriation of not exceeding $50,000 be made for the purpose of this investigation.

Third. That the National Electric Light association hereby tenders its thanks to the Hon. Robert P. Porter, superintendent of census, for the recognition he has given to the importance of and wonderful progress made by the electrical industry, in the appointment of a special agent for its investigation, and we hereby pledge our cordial co operation with the census office in its efforts to make the investigation thorough, reliable and complete in every detail.

Fourth. That a copy of this preamble and resolutions be properly engrossed, officially signed by the president and secretary of the association, and transmitted to the chairmen of the committees on census of the Senate and of the House of Representatives, and to Hon. Robert P. Porter, superintendent of census.

The resolution was adopted.

Freight on Carbons.

Mr. Lawrence of Cleveland offered a resolution which was handed to the secretary, whereupon F. A. Wyman made the point of order that all resolutions should go to the executive committee to be approved by it before being presented to the association. The president announced that the resolution was referred to the executive committee. President Weeks, when asked upon what ground he ordered the reference, said the constitution provided that the executive committee should arrange and provide for the programme and order of exercises. He said he might add the resolution was submitted by an associate member but it should be offered by an active member.

Mr. Weeks subsequently reconsidered his decision in regard to the necessity of referring the resolution, and the resolution offered by W. H. Lawrence was presented as follows:

"Whereas the present classification of electric light carbons is much higher than other commodities of corresponding weight, bulk and liability to damage; packages less than car lots being rated as first class, and car loads lots as third class; and this classification was made years ago when few carbons were manufactured, when they were high priced and supposed to be very liable to damage; but are now among the cheapest shipped, are compactly and securely packed, easily handled and not liable to damage in the ordinary risks of transportation, which is demonstrated by the fact that no claim for breakage of, or damage to carbons has ever been preferred to the railroad.

"Therefore be it resolved that the National Electric Light association in convention assembled, considers the present classification unjustly burdensome, and believes the interests of all electric light companies will be promoted by reducing the classification, and that greater volume of traffic and corresponding gain to the railroad companies will accrue:

"And be it further resolved that this association indorses the efforts of the committee of carbon manufacturers appointed to make application to the general freight classification committees of the United States in furtherance of this resolution."

The resolution was adopted, seconded and carried.

The following committee on nomination and place of meeting was appointed, Mr. Huntley, Mr. Francisco, Mr. Beck, Mr. De Camp and Mr. Beebe.

Place of Meeting.

Mr. De Camp: I move you that when this convention adjourns at Kansas City, that it adjourn to meet in the month of August, 1890, at such a day as the executive committee shall decide upon to meet at Cape May, New Jersey.

The motion was adopted.

The convention adjourned to meet Friday morning at 9:30.

Friday Morning's Proceedings.

President Weeks called the convention to order at 9:30 A. M. C. R. Huntley presented the report of the committeee on nominations, as follows:

President, M. J. Perry of Providence, R. I.

First Vice-President, E. W. Maher, of Albany, N. Y.

Second Vice-President, C. L. Edgar, of Boston, Mass.

Executive Committee. C. R. Huntley, chairman; E. R. Weeks, Kansas City, Mo; James English, New Haven, Conn.; S. A. Armstrong, Camden, N. J.; M. D. Law, Philadelphia, Pa.; M. J. Francisco, Rutland, Vt.; A. F. Mason, Boston, Mass.; John A. Secley, New York; H. K. Thurber, New York.

Dr. A. F. Mason: I desire, sir, in a word of explanation to make a nomination. I think that every member of this association recognizes, with something akin to gratitude the very felicitous, the very remarkable services of the present president of the association. I believe that I do not speak for myself alone, but for every member of the association, when I say that we have had an exceptionally profitable as well as enjoyable meeting here in Kansas City; and that very largely this is due to the efforts of our president, E. R. Weeks. I, therefore, desire to put in nomination for the presidency of this association for the ensuing year, E. R. Weeks of Kansas City.

A. J. DeCamp of Philadelphia: That nomination being made, outside of the committee, I think it requires a second. I arise to second the nomination. Whatever we may be glad to do as a body of men, we certainly owe one thing, and that is a proper appreciation for those who have already served us. I think I am justified in saying, of all the meetings that this association has held, there has been evidence of a healthy growth. But like the growth of our country, we have in that total growth made a stride The step from our last meeting to the present, comes under that class: It is a stride! This is the most largely attended meeting that we have had. There has been the greatest interest taken in it, and our work has been of the most practical kind, and I think that it has been due very largely, if not entirely, to the efforts made by the president of this association. He has been, during the last six months at work constantly, or the results that we see could not have been accomplished. I would be glad to have him fully appreciate the feelings of this association.

President Weeks: Gentlemen, your action in this matter is gratifying to me, in that it evinces your approval of the administration just drawing to a close Next to the consciousness of having done one's best comes the approval of one's friends and associates; but, gentlemen, my views of the presidency of this association have not changed. It is my opinion that the president of the National Electric Light association should be a citizen of one of the larger Eastern cities, one of the great electric centers, if I may so speak, of the country, where he can carefully watch all movements affecting the interests of the industries that we represent. Kansas City is not such a center, although Kansas City will sometime undoubtedly be just such a place and the place where, for this very reason, the president of some future convention of this association, might well be located; it is not so now. I, myself, have during my administration, felt frequently the disadvantage of distance; and if the interests represented in this association have not suffered, it has been due largely to the zeal and support of the Eastern members; it has been due largely to the vigilance of our secretary and the earnest watchfulness, to the zealous application and industry of our Eastern committee. The success of this convention, gentlemen, which has been so kindly at-

tributed to me is due very much more to the combined efforts of those gentlemen who have supported the administration, and have looked out for the interests of the association so carefully.

For these reasons, gentlemen, I feel, much as I appreciate the honor that you offer me, that the best interests of this association require the election of the officers nominated by your committee. In the expression that has been made and in the increasing prosperity of this association, in the strengthening of the association throughout the West, which was the reason for my acceptance of this office, I find my reward. I thank you, gentlemen, for your offer, but for the reasons stated, I must respectfully decline the nomination.

E. A. Armstrong stated that it would be unwise, both in justice to the duties of the position, and unwise from a personal standpoint, to accept a place on the executive committee. He suggested the name of Mr. Burleigh as a substitute.

A motion to substitute J. J. Burleigh in place of Judge Armstrong on the executive committee, was then put and unanimously carried. The secretary was instructed to cast the ballot of the association for the officers and members named in the report as amended.

Frank J Sprague of New York followed with a paper on "Electricity as Applied to Street Railways," as follows:

Electricity as Applied to Street Railways.

BY FRANK J. SPRAGUE.

Scarcely fifteen years, a period of time yet within the memory of the youngest of us, have passed since the beginning of a new era, the era of the transmission of energy for light, power and the reproduction of speech Of the progress of the first I need not speak, for the delegates of this convention are well cognizant of its history and the advance it has made within that time. The spread of the telephone to nearly every town and hamlet in the fourteen years since it was exhibited as a scientific toy at Philadelphia, and the financial success of the parent company are facts continually before your minds, or ringing in your ears. But that great industry, the transmission of electricity for power, with its possibilities of all kinds, is of very recent development. Six years ago there were scarcely a hundred electric motors in operation in the United States for any purpose. To day there are no less than 15,000 motors in use, applied to not less than 200 different industries, and an industrial revolution is taking place equaling, if not surpassing, in importance that attending the introduction of the steam engine, and marvelous in the rapidity of its growth.

It is not my purpose to dwell at length upon the subject of the transmission of power by electricity in its general application, but to touch upon one branch only, that of railway work, reviewing very briefly the development in the United States, pointing out the salient features of successful operation, noting what has been already accomplished, and after some remarks upon the legal questions which have arisen, considering the possibilities of the future.

The modern electric railway may be said to have been born in Europe; its babyhood was in Europe; but in its youth and younger manhood it is purely American. In 1881, Dr. Siemens of Berlin, established the pioneer railway on the Lichtenfelde line in the suburbs of Berlin, and I believe it is still running. It was followed by other roads, some commercial and others for exhibition, erected by the firm of Siemens, and by work done by other electrical engineers. The Siemens also established a line at Frankfort. The Doctors Hopkinson established one at Portrush, Ireland. Another was established at Blackpool. This last was a conduit system. A double metallic overhead system was established in 1888 at Vevey, Switzerland, and comparatively recently the Siemens have established a conduit system at Buda Pesth.

The first line which was established in the United States for actual commercial service was a surburban line of two miles in length, built by Mr. Daft just outside of Baltimore, in the latter part of 1885, using a central rail. Other lines were established by Mr Vanderpoele in various parts of the country, using the single and double trolley systems, with the trolley traveling upon and carried by the wire and connected to the car by a flexible cable.

In all this pioneer work the system used was that of direct supply, but most of the mechanical features as well as the electrical details have now given way to other and more efficient methods of operation.

Of the more recent work three classes demand attention, one being the system of independent units operated by the storage battery, and the other two being direct systems of supply, one under ground the other overhead. I shall not enter into details of these three systems or their modifications, for it would be a repetition of much which has already been written, but I will briefly state the facts, and the conclusions I have formed concerning them.

There is something exceedingly attractive in the proposed application of storage batteries to the propulsion of cars. To be able to conveniently store up a large amount of energy in a box, put it aboard of a car, carry it around with us, and take from it a greater or less amount of work, offers, when practicable, a solution of the street car problem for which we are all devoutly hopeful. But look at it commercially. The storage battery is still a long ways from being a serious competitor of the direct source of supply. True, great improvements have been made in it, but these improvements have not very much altered its character, or the weight which is necessary, or the care which must be exercised in getting an economical return from the battery. These improvements have made it possible to take a heavier charge from the battery without producing buckling, have made a rougher usage of the battery mechanically possible, and have in some instances greatly reduced its cost of manufacture, so that the element of maintenance is a less serious one than it was a year or two ago; but the capacity of the battery, while it has been somewhat increased, remains such that it is still necessary to have about 3,500 pounds to propel an ordinary street car. This means an excessive weight. It takes up space and is a serious extra weight to be carried around. It requires frequent shifting, and its capacity as well as discharge rate are so limited that it is simply impossible to work such a battery upon grades which are at all severe. I believe it is possible with care to operate a storage battery on grades not exceeding, say, 4 per cent., and with limited speed and daily mileage at an expense about equal to that of horses, or a little less; but still at about double the expense which is necessary upon a suitably erected and properly operated overhead system.

Nowhere in the United States, that I am aware of, is there serious storage battery work being done at the present moment. The nearest attempt was where recent experiments were made on the Madison avenue line, New York City, where about a dozen cars were being run up until 8 o'clock in the evening; but owing to legal complications, only two cars are now running there; with what daily mileage, I do not know. But nowhere is the work done at all, equivalent to what is constantly practiced on the overhead line. On that service motor cars start out at 5 or 6 o'clock in the morning, and run until midnight. Many cars make 150 or 160 miles a day, and some cars have even made 180 and 190 miles a day. Half of this for storage battery work is good duty, but it is not up to the demands which street railway managers make, and until radical improvements are made in it, the field of application will be limited.

The conduit system of direct supply has been attempted in several places, notably at Denver, Cleveland, Allegheny City and Boston, but at all the places mentioned these experiments have proved disastrous and have been abandoned save the short section at Allegheny City. In England, the Blackpool line under special conditions has been I believe fairly successful and at Buda Pesth, the Messrs. Siemens have a conduit system in successful operation. There, however, the drainage is very perfect, and in addition a man is detailed for given sections of the track, and is continually employed in patrolling his section and clearing it out. Assuming good sewerage, the conduit can unquestionably be made to work. It becomes then a question of cost; but for general application, especially in view of the fact that most of our cities do not have a sewerage system which can take care of the street drainage, the expense is prohibitory save on large systems under exceptionable conditions. I look forward to the time when many existing, well constructed and well drained cable conduits will become electrical conduits, and electricity will then score another victory.

The system, however, which has made such a marked advance is the single trolley overhead system with universally flexible underneath contact, and this has been the growth of the past two and a half years I think I can fairly claim for the Sprague company the pioneer place in this development, but the commercial development on the lines it laid down has been with great energy pushed forward, principally by both it and the Thomson-Houston company. The first work done by the Sprague company, other than experimental work on the elevated railroads, was made but a short distance from this city. A single car was started in 1887 on the Union Passenger Railway company's line in St. Joseph, with a small 7½-horse power motor, single geared, and adapted to run at a very high speed on a suburban extension. It is a matter of interest that that line has seen nearly every change made in the system. Its lines have been extended twice, and it has both the old style motors and the more modern equipments. But all the work done on that line in 1887 was, it may be said, purely experimental; and it was not until the 2d of February, 1888, that the Richmond road was officially opened to the public I speak of this road not so much because of my personal interest in it, but because it marked an era in the development of electric railways. A radical departure was made from the work which had been done prior to that time, not only in the amount and extent of the system equipped and the number of the machines operated, but also in the disposition and control of the machines, the system of overhead wiring, and the method of getting the current from the wire. The characteristics of that line are now pretty well known. It was a road of about twelve miles in length, with thirty curves, some of them of exceedingly short radius, with grades running as high as 10 per cent, and with a roadbed utterly unfit for the traffic which it had to support. The equipment was for forty cars, requiring eighty machines, and was to be operated from one central station. When first proposed the attempt was looked upon with a good deal of ridicule, not only by street railway men but by electricians themselves. The street railway men thought that the ordinary condition of street car service would make it impossible for a self propeller car to ascend a grade exceeding 5 or 6 per cent., and as for attempting a 10 per cent. grade, that was out of the bounds of reason. As regards the electrical problems, the motors instead of being placed on the car body flexibly, connected by chain gearing or belts to the axles, were placed underneath the car, and flexibly and concentrically geared to the axles. They were uncovered and exposed to the mud and moisture, and to all the loose combinations which might accumulate in the street. They were built to run on a 400-volt grounded circuit, and to run in either direction with fixed brushes. Insanity was a mild term to designate the mental condition of one who made these proposals. The motor man was confined to his ordinary platform, and the regulating devices there situated. A wire of one-fifth of an inch in diameter was extended over the track, and supplied at intervals of its length by a wire carried alongside the street where the strain upon the poles was least, and this main conductor was supplied at three or four central points by feeders, which came from the central station. The current, moreover, was taken from this wire, not by a traveling carriage upon the wire, flexibly connected with the car, but by an arm reaching upward and pressing underneath the wire. This contact arm, which is now technically known as the trolley pole, was placed in the center of the car and had a universal movement, resisting up and down movement sufficiently to make a good contact with the wire, but at the same time free to follow all vertical deflections. In addition it had a lateral movement of considerable reach, offering little opposition to any side deflections by the wire itself.

Well, Richmond has passed into history. It has had its vicissitudes—it has had its victory as well. But it remains with all its crudities, and with all the accidents which have marked its career, as the one great step in advance, whose features, in the main, have been followed in almost all the recent electric railways. Machines have been made larger, they have been made mechanically and electrically more perfect. Changes of detail have been frequent, but most of the characteristic features there outlined, mark to-day nearly every electrical railway which is either in operation, in process of construction, or under contract.

Taking our work alone, and that of 1887 as a basis, in 1888 it was trebled. The work of 1888 was quintupled in 1889. As to what it will be in 1890 I will not hazard a guess. Two years ago it was in an experimental age, and it was difficult to get a dollar for investment; to-day it demands the best thought and the most active energies of two great corporations and a number of smaller ones. The contracts for electrical equipments involve larger amounts than almost any other electrical enterprise. The business done in this year will probably be not less than $6,000,000. Every street railway in the United States is watching with eager eyes the developments of the rival electrical interests. The advocates of the cable system are on the defensive. The advocates of the electric system are reliant and aggressive Its flexibility, the ease with which it is extended, its adaptability to various conditions of service, its freedom from a long continued break-down, the marvelous advances which have been made in perfecting its apparatus, all insure its supremacy.

As illustrating the progress of electric railways, I may state that there are about 130 towns in the United States with one or more electric railways in operation, construction or under contract, and that these roads comprise about 1,500 miles of track, equipped with about 1,700 motor cars, requiring 3,000 motors of an aggregate capacity of 45,000 horse power, and steam and electrical generating about 100,000 miles per day, and within three months the mileage will be doubled.

We still bear occasional discordant cries about the possibility of break-downs, the cost of operation, the danger of the current or the unsightliness of overhead wires.

This latter question is rather esthetical than practical, for as now erected, the railway lines are among the most costly, and with care can, in view of the service rendered, be made very unobtrusive.

As regards danger, the electric car is the safest possible vehicle, because of the remarkable facility of control, and as to the objections to the overhead line on the score of danger which have been raised, sometimes by the authorities, and which have been acted by the telephone interests, they are, we may safely say, imaginary rather than real. Some two years and a half ago I settled upon 400 volts as a fairly satisfactory standard of potential for which the motor for street railway service should be built, allowing about 10 per cent. drop in the distribution on the line, making the potential in the station about 440 to 445 volts. In some cases, where dealing with heavy work on extended lines and small conductors, we have raised the potential at the motors to about 450 volts, making no change whatever in the machine, and have run the central station at 480 to 500 volts. There are in the United States about 80 electric railways in operation. Almost every employe of the contracting companies, and a great many employes of the railway companies themselves, including not only the linemen, and those whose business it is to work upon the electrical equipment, but also the conductors and drivers, have received shocks from these lines of greater or less duration, and under almost every possible condition. Yet, in no instance which ever came under my observation, or of which we have any reliable record, has serious injury resulted from the shock of the current itself When we consider that these shocks have occurred to persons of all ages, and of all physical conditions, and for varying periods, the experience seems to be quite ample to warrant the assertion that as ordinarily constructed a constant potential circuit of 500 volts is not dangerous to human life, and we can dismiss that question.

Reviewing the work of the past two years, that which was promised for electricity has been in the main entirely fulfilled. It has proved itself capable of doing the most extraordinary work under the most unfavorable conditions. Grades of 12½ per cent. and more recently of 14 per cent. have been ascended with loaded cars. Grades three miles long varying from 4 to 8 per cent. have been ascended by a motor car pulling a tow-car. It has done this work where it would have been impossible to have done it by horses. It has enabled the running speed of cars to be increased even in crowded cities 50 per cent.; and on suburban routes speeds of 20 miles or more have been made. Experimental runs of 30 miles an hour on the ordinary street car with the narrow flange wheel have been attained;

and on special experiments a speed of nearly 150 miles an hour has been attained for a short distance. The electric car has shown that it can run faster on both up and down grades; that it can be gotten under way and stopped more quickly than a horse car; that with any given number of cars the mileage has been increased and at the same time intervals made with a less number of cars. Many cars have made from 180 to 190 miles in one day. Horse space having been saved, the equipments occupy a third less space, and this fact, coupled with the ability to back when necessary, and again quickly gain headway, has enabled an electric railway car in crowded and narrow streets to work its passage where a horse car would be at a dead standstill. Not only has the possibility of running down grade faster been established, but that possibility with a high degree of safety, because in the event of losing control of a car by the brakes, the instant reversal of the motor will bring the car to a standstill. This has frequently been the experience, and in one case, which was recently reported to us, the inspector stated that a car was going nearly thirty-five miles an hour on the down grade before the driver attempted to reverse his machine; but when he did reverse it, he brought his car to a staudstill with the loss of only one gear. Making due allowance for the possible excitement of the inspector, I think the car was moving at least twenty-five miles an hour when the reversal took place.

The riding of an electric car is unquestionably easier than on the majority of cable or horse cars, starting and stopping more easily and being in a very large measure free from oscillation. It is scarcely necessary to say that the cars are cleaner, that they are brilliantly lighted, and that it would be possible even to heat them by electricity. The sanitary conditions are entirely altered, and the health and comfort of the people conserved by doing away with stables with all their unsavory characteristics and resultant injury to the value of adjacent real estate. Branch lines of every possible combination of grade, curve and ill-conditioned street, which have so often proved prohibitory to any other system of propulsion, have been operated by the electric system. Distances up to six miles or more away from a single station have been operated without difficulty, and large numbers of cars from one station. It can very properly be said that there have been many break-downs; that machines have depreciated; that there have been exasperating troubles. True, these things have happened; and in case of defective workmanship and of careless inspection or management, they will happen again, no matter what system of propulsion is adopted. The accidents which can happen to a motor come within a very limited category, and the liability of a motor to these accidents is being very rapidly reduced to a minimum, till it is becoming to-day the most perfect piece of machinery, capable of the longest continued use, of a large amount of abuse. The very accidents which have happened, as simple as the causes are—and I may say here that nine-tenths of electrical troubles are due to mechanical defects—and the very makeshifts which have been temporarily resorted to to overcome the troubles and keep the lines in operation, are the best evidence of the flexibility of the system and the perfection to which it will arrive. No other machine in existence has, in so short a period of development, been brought to such a degree of perfection, is capable of such varied application, and can be so quickly and easily understood.

The cost of operation has proved entirely satisfactory, and my early claim has been substantiated. In a paper read before the American Institute of Electrical Engineers in August, 1888, and also in some earlier communications, I made an estimate as to the expense of operating a thirty-car road, dividing these operating expenses under two heads; (1) those belonging to the central station; and (2) what may be called the road operating expenses; the sum of the two constituting the total cost of motive power. In making this estimate I used extreme care, and while preserving its accuracy, made every reasonable allowance that I thought necessary. The conclusion at which I arrived in the estimate under the conditions there given, was, that the total cost of motive power per car mile should not exceed 4 3-10c, each; and this included everything except executive and salary expenses, taxes and insurance, and other matter not connected with motive power. I also stated that this was about 40 per cent. of the cost of operating by horses for the same number of cars and under the same conditions. My estimate was then considered altogether too liberal in favor of electricity. Without going into details I may state that the most reliable possible records of roads, under every possible condition of service, bear out the claims that I then made as to the economical operation by electricity. I have the records of only a portion of the roads which we have equipped. Some roads see fit to make public these records; others, and with a good show of reason, do not care to do so because of the feeling that municipal bodies in considering the granting of franchises will not look at the increased cost of investment, but, ignoring the manifold advantages to be gained by the introduction of electricity, for the public as well as for the company, are inclined to make unreasonable demands in the way of the reduction of fares, or require unnecessary and unprofitable extensions of lines. They forget that the reduction of one cent in a fare means a cut of 20 per cent. in the receipts of the company, and that a very remarkable saving of expenses must be made in order to meet this reduction of revenue, especially where there is an increased equipment on which interest must be earned. But suffice it to say that careful investigation will convince any candid man that the economic claim has been entirely supported, and the best evidence of it is in the rapid adoption of this method of propulsion.

A few remarks may be in place relating to the interferences with other established interests which this new application of electricity has developed Such conflicts, as electricity is applied to different industries, necessarily arise and result from the claims made by two or three enterprises to the same area of occupancy, whether of air or earth. There have been, long before electric railways became at all common, conflicts of a more or less limited nature between the electric lighting and telephone interests. In the early days of electric lighting, and more particularly in that branch known as constant potential distribution, an attempt was made to use the earth for one-half of the circuit, precisely as was done and has been done for years in telegraphy. Practical experience, however, demonstrated that this was a mistake where incandescent lights were concerned, and it is manifestly a mistake where arc lights and high potentials are used. The objections on the constant potential incandescent circuit were pertinent because of the liability of fire in the buildings where the ground circuit was used; and the element of personal danger very quickly put an end to an attempt to use a ground circuit for an arc light system.

The same cautionary reasons applicable to these two classes of industries do not, however, apply to overhead electric railway systems. The electric railway circuit is purely an external circuit. Its derivations are through the cars which it supplies. It is led into no dwelling; its fixtures are not within the ordinary reach of any being. It is carried in the open air, in full view, in the most direct possible lines, and with only such supports as are necessary to make its construction safe and to keep it in alignment. The whole construction of an overhead electrical system is materially simplified, and, in my opinion, made, mechanically as well as electrically, far safer by the adoption of a single wire, using the rails as a return circuit. The practical proof of the wisdom of this decision is the fact that about 90 per cent. of all the electric railways, either in operation, construction or under contract in the United States, use only the single wire underneath contact. It scarcely seems necessary at this stage to go into the defense of this system. Its simplicity, the lightness of construction, the symmetry of outline, the size and strength of the poles, the fewness of the supports, the simplicity of all curve work, turn-outs, crossings and sidings, and especially of all switch work and switch operations, are so manifest that elaboration of these features is unnecessary.

The use of the grounded circuit has unquestionably interfered with another and widespread application of the use of electricity, and that is the operation of telephones which likewise use the grounded circuit. So long as electric railways were in an experimental stage, running perhaps in suburban districts, out of the way of telephone circuits, little or no attention was paid by telephone companies to their existence. The strides which have been made in the past two years and a half, bringing the railway system into the very heart of towns and cities and into the forefront as a commercial enterprise, the rapid increase in the extent and use of the telephone system, have brought the two interests in direct conflict, which conflict is solely because of their common use of that great reservoir of electricity, if we choose so to term it, or rather that great common medium for conducting it which has been used alike by railways, telephones and telegraphs since these industries were started.

The claim of the telephone company in brief is, that by right of prior occupation and because of their vested interests, no electric railway or other circuit shall so use the earth if interfering with their lines in any way. Their claim is far-reaching; it is of the broadest possible character, and, strictly interpreted, is an exclusive claim on the use of the earth for transmitting energy by electricity. That there is an interference with the telephone circuits by an electric railway circuit is undeniable, and the interference is one which is annoying. The character of the interference is two-fold. Part of the trouble arises from induction, that sympathetic response in the telephone circuit to any changes in the electrical condition or leakage, and is caused by the diverting through the telephone system of a part of the current which has been discharged into the earth and is on its way back to the central station

The relative amount of these two interferences has been variously stated. On the part of the telephone company it is admitted that conduction or leakage is a source of trouble. They also admit that the use of any metallic return circuit, it matters not what, whether it be an individual circuit for each telephone, or a common metallic return for all the telephones, will obviate this or most of it. Even this much is admitted by the telephone interests with a great deal of hesitation, despite its perfectly apparent truth. But they go further. They claim that this is not the principal cause of trouble, but that most of it is due to induction, and that if a return metallic circuit overhead were put up by the railway company—that is, if a double trolley system were used—then the telephone troubles would all cease. The various attempts they have made in the courts have been with a view to either compelling the railway companies to cease operations or to so change and erect their entire system as to abolish the use of the single trolley and erect in its place the double trolley system, or, on the other hand, to compel the electric railway company to pay for the necessary changes required in the telephone circuit to avoid the interference. No sooner was this issue presented than it was promptly met by the railway interests which I represent.

Now what are the facts? First, as I have stated, there is unquestionably an interference between the electric railway and the telephone service; but of the character of this interference, it seems to me that no intelligent man who honestly makes an investigation seeking after truth and truth only, and not biased by the commercial interests which have retained him, can have any reasonable doubt. The assertions made by the telephone interests leave little room for exaggeration on their part. Not only has the character of the interference been misrepresented, but the costs of any changes made necessary on the part of the telephone company to avoid trouble, or on the part of the railway company to change over its system, have been grossly misstated.

As a matter of fact the trouble from induction is of the very slightest character, and that must be patent to any one who is familiar with this particular electrical action. Generally the trolley wire is situated in the middle of the street, anywhere from twenty to thirty or forty feet away from the telephone lines. It rarely runs parallel to them except for a comparatively short distance, possibly two, or even three miles, but more often less. The current used upon this wire is not of that character which distinguishes some of the arc light circuits, but is of more or less even flow, and the abrupt and large changes due to change of load on the motor are comparatively infrequent. There is a very small change due to the variation of resistance of the armature of the motor, because of the different relative positions of the commutator blocks under the brushes, and there is likewise a variation due to the slight but rapid changes of counter-electromotive force set up by the motor when running. But although these changes can be detected inductively, provided the conditions are favorable, for instance, if both the telephone and railway circuit were wound around a common bar of iron, the character of the disturbance is not so serious as to preclude conversation. But the trouble which does really become pronounced is that which is due to the actual differences of potential which exist on different parts of the track circuit, in other words, at the terminals of the grounded telephone circuit. There is discharged into the earth, as I have pointed out, a slightly varying current. It may be at some point considerably removed from the station and in close proximity to the ground terminal of a telephone whose exchange is likewise grounded at another point much nearer, electrically, to the station than the point of discharge. The current reaching the rail has to travel back to the station, partly by the rails and partly by the earth. Both offer more or less resistance, and there is an actual difference of potential between the point of discharge and the station, arising at times to as high as 20 or 30 volts; but it is, of course, a variable potential, and the current which flows over that path is one which varies in its character. Having discharged the current in the earth, there is absolutely no limit to its diffusion. We desire of course that it should return by the rails, but no boundary can be placed upon it. A part of it goes through the rails, but some portions will go through the earth, through waterways, mineral veins, gas and water connections, electric light tubes, telephone circuits, rivers and canals, and in fact, over any and all paths which offer it opportunity to return to the source from which it originated. The shortest geographical line between two points may be a thousand feet. The paths of the current between these two points may be anything from a thousand feet to fifty thousand or more. But precisely as the rail current is thus disseminated or diffused in its return paths, so also is the telephone current. True it is only a current of small capacity, so small as to interfere with no other enterprise or translating device except others of like character, but its diffusion is of precisely the same character and over the same territory and through the same classes of conductors as that of the rail current. Could the telephone current be limited in its path, and the claim of the telephone company be narrowed down to a specific section of earth, then possibly there might be some basis for the claim to the use of that section, but such a restriction is, of course, manifestly impossible. Hence, any claim the telephone interest makes to the earth must be vague; it must be all reaching; it must be exclusive. It would seem that it has no more legal right to make a claim which prohibits a railway in the town in which the telephone circuits are operated from using the earth, then it has to make a claim that a railway in any other city with which the telephone may be remotely connected shall be prohibited likewise from using the earth in that particular city, although it may be a hundred miles off. It is a well-known fact among electricians and probably no better known than among the telephone people themselves, that, perfectly independent of railway enterprises, a far better service can be rendered the patrons of the telephone where a complete metallic circuit is used and the use of the earth abolished. The telephone is the most jealous detector possible of all disturbances of electrical condition on the circuit which includes it. Its very function as a transmitter of speech depends upon this marvelous delicacy. As now operated in the majority of telephone exchanges it is subject to continual interference not only from the railway circuit but from every electric light, power, or telegraph with which it is brought into proximity. It is subject to interference from atmospheric changes and discharges. The telephone circuits themselves interfere with each other. Cross-talk and false signaling are common. Almost all these troubles can be avoided and the telephone service made far more perfect by using either the individual metallic return with the switch-board properly constructed for it, or the individual return, the return wires coming to a common terminus, which would make absolutely no change in the telephonic switch board; or what has become known as the McCluer device, the use of an artificial metallic ground or common metallic return—that is, by breaking the ground connections of the individual telephones and connecting them all to one common copper return of a resistance which shall be low compared with the resistance of the instruments themselves. The lower the resistance of this common return the less any interference of the telephones with each other. The cost of this latter method is a bagatelle. It should

be put up by the telephone companies for the sake of their patrons, independent of whatever other electrical enterprise they may be brought in contact with. Wherever intelligently put up the relief from outside interference has been almost absolute, and the testimony of parties who made complaint when telephone companies first sought to obtain an injunction against the railways is now emphatic to the relief which has been obtained by this change in the method of running the telephone circuits. It is unquestionable that the telephone company is waging the warfare from the standpoint of economy, pleading the rights of vested interest. Notwithstanding every telephone expert knows the great advantage to be gained from a metallic circuit and notwithstanding the fact that sundry papers read at telephone conventions not only admit that the metallic circuit is best but give testimony from the exchange superintendents that wherever their patrons once use the metallic circuit and long distance telephone, they are never satisfied thereafter to use the grounded circuit. It is likewise suggestive that the Bell Telephone company to day advertise no less than about 150 local stations in New York city equipped with the long distance telephone and the metallic circuit. Since there is not an electric railway in the city of New York, their action in this locality could not have been dictated by interference from that interest.

The position from a legal standpoint seems to be something as follows: As between telephone and electric light and power companies there may be a question concerning respective rights, because the electric light and telephone companies may both occupy the highway as of equal dignity. But even in such a case neither one of the interests can have just right to an injunction, because the proper way of redress is a suit at law to determine the amount of damages for which the one party is liable on account of a violation of the other's rights, permanent injunction being granted, I believe, only where the troubles are irremediable, or where the damage cannot be readily computed. Wherever the telephone company, however, seeks to trammel electric railways in their free use of the public highways, and especially where they have been granted the right of such use, an entirely different question is presented. The public highway was originally and primarily dedicated to public travel, whether by foot, by horse or by vehicle, and for no other purpose. It was contended some years ago that street railways ought not to be allowed upon highways because they had tracks, but wherever courts have been called upon to make a decision, it has been held that street railways were but an improvement upon the old methods of travel. It was even at one time questioned whether there might not be a distinction between the rights of a street railway where the public owned the fee and those in which the title was in private individuals, but even this distinction was not allowed. When electric railways were developed, an attempt was made to claim that they were a perversion of the highway; but it was then held that electric railways were an improvement only upon street railways propelled by horses or other motive power, and should occupy the highways with the same rights as were enjoyed by the street railways using the other motive power before electric propulsion was resorted to.

Since both the telephone and the railway companies occupy public streets by public license, it is of course necessary to examine into the source of their respective titles and the character of their occupancy, because otherwise it would be impossible to understand what are their respective rights. The electric railway has proven a great advance upon any method of street car propulsion hitherto known. It has been shown to be economical, safe and advantageous as a method of public travel. It certainly cannot be said to be objectionable *per se*. It interferes less with the travelers upon the highway than many other methods of propulsion, and its very extended use shows that it has been sanctioned by public authorities as a safe and proper method of travel. The single trolley system being used by nine-tenths of the street railways in the United States using electric motor power, as against all other methods, certainly shows that practical experience is in favor of that particular method. As an improvement upon the method of propulsion it would seem that an electric street railway uses a public highway, occupies the same, and enjoys the right of travel theron as of equal dignity with any or all other persons or vehicles upon that highway, and that this right of enjoyment is within the original purpose for which the highways were opened. On the other hand, it is pertinent to inquire what right or title a telephone company has in the street. By virtue of the original dedication of the highway they have no rights except that of toleration. Telephone and telegraphs are identical in contemplation of law, and have been held to be an additional burden upon highways. In almost every case where this question has come up in the matter of telegraphs, such has been the decision. The statutes under which telephone or telegraph lines are permitted to be erected in highways provide that while they may be so erected, the poles and wires shall not interfere with public travel upon the highways. Since this is true the telephone companies are upon a public road not by virtue of right, but of toleration; not as the equals of the street railway, but subordinate to it. They occupy a secondary position, and this being the case, where conflict arises between the two, it would seem that the telephone company must eventually yield, for its claim against any competitive enterprise is nothing less than a claim to the exclusive right of the earth, not to some section of it, because there are no limits in which the telephone wires may not reach boundaries to the portions of the earth which form a part of their circuits. Certainly no statute gives an exclusive privilege to a telegraph or a telephone company; and any claim for such an exclusive right, to be substantiated, must show an express or implied grant from some source, and the boundary as well as the source of that title. Not only this, but it must show that the title is exclusive. In view of the fact that the telegraph companies had used ground circuits for thirty years or more before the telephone was discovered, and that patents were refused for such use, it will be somewhat difficult for the telephone company to show the source of its title, and it is manifestly impossible to show the limits of the territory from which any other enterprise must be excluded so that it will in no way interfere with the operation of the telephone system; for the telephone circuits being attached to gas and water systems of the community in which it is located, the ramifications of such systems and of all the subterranean electric conductors of the earth in contact with these metallic conductors are unknown to science. How other electric currents entering the earth may do so without invading the charmed area of the telephone and disturbing its grounded wires no man can say, much less can the telephone people themselves. The boundaries, then, of their claim being so vague, it would seem that their claim itself must necessarily fail.

Within the past two years there have been, I believe, eight attempts made by the telephone interests to get an injunction. The first was in Akron, Ohio, in the latter part of 1888, where the Central Union Telephone company of Chicago attempted to restrain one of the Sprague roads by injunction. This was denied. The next suit was against the Harrisburg road and the Sprague company by the Penn Telephone company. A number of common stockholders, I believe, were interested in both companies, and although the attorneys of the railway companies were fully prepared and desirous of seeing the case brought to trial, the case was abandoned and compromised for the very sensible reason that it would cost less on both sides to compromise than to carry the case to the higher courts. The next attempt on the part of the telephone interests was in the application for an injunction against one of our roads at Chattanooga, Tenn. This injunction was denied. Then came a conflict in Salt Lake City, where many of the people were so interested that they said, as between the telephone and electric railway interests, if the decision was against the railway company they would abolish the use of the telephone. Such heroic measures apparently were unnecessary, for the injunction was twice denied. Then application for an injunction was made in Cincinnati, and this will probably become a *cause celebre*, for an injunction, on what ground I do not yet know, was granted, and the case will be carried to the higher courts.

In Eau Claire, Wis., an attack was made on the railway interests under cover of a state law which the telephone companies had quietly gotten passed requiring a return insulated conductor for any circuit carrying electric energy. The injunction was there denied, for the telephone company had somewhat overstepped itself and found itself quite as much in the mud as the railway company might be in the mire so far as the law was concerned because they were themselves the carriers of electric energy and were using grounded circuits and consequently had no standing before the court. The last case with which we have been directly concerned is one at St. Joseph, which has not yet been tried. In Albany, where another electric railway company is operating, the telephone interest has succeeded in getting a temporary injunction. I believe this case, in which my own company is not particularly interested, except sympathetically, has been recently reheard and a decision on the merits is now pending.

With the records thus given, it would seem that the electric railway companies have little to fear from the attacks made upon them by the Bell Telephone company. They are well within their right and that being so their position must sooner or later be established beyond all peradventure. The cases which I have enumerated are not the only cases in which there have been interferences between the electric railway and telephone; but in almost all others both the railway and telephone companies have recognized each other's moral, if not legal, rights. Often the same stockholders have been in both companies and a sensible compromise had been effected, in which the telephone company has sometimes changed the route of its circuits, or put up a common return, or the companies have used each other's poles, and a just division of expense has been settled upon. This would seem to me to be the better plan wherever conflicting interests arise, and is one which I would recommend in all cases where the telephone companies are willing to recognize the justice of the legal position of the railway company, instead of attempting, as they have been in the cases mentioned, to deny that right. A just compromise, but no surrender, should be the motto of the railway company.

So much for street car practice; and looking forward we naturally ask what will be the future of the application of this remarkable agent? Already we have gone from one car units to trains of 2 3 and even 4 cars in the street, and 40 cars have been operated from a single station. The next step will be the operation of some of the cable roads; then systems like the underground railway of London, the elevated railways of New York, the Brooklyn Bridge system, and then suburban lines will be operated. But is this the limit?

I have been frequently asked whether in my opinion, electricity will ever be used on trunk lines for through passenger or freight traffic? My answer is, probably not, according to present notion of trunk line transportation, and not by present methods of train dispatching. But in these qualifications I admit my hope and expectation of rapid through transit under certain conditions. Let us for a moment consider a few facts.

Railroad managers are constantly meeting with a demand for more rapid and luxurious methods of transit, and every effort which executive ability and financial expenditure within reason can devise, is made to meet this demand. I think I can safely say that as steam railways are operated, a maximum speed of ninety miles per hour, and a running speed of sixty to seventy, is all that can be hoped for in steam railway travel under the best conditions which can be provided. The limitations are too many. The maximum speed made by a locomotive to-day is but little more than was made 20 years ago. True, engines are larger and more powerful, but the increased weight of trains has made this necessary. To get pulling power there is a limit to the size of the drivers, and whatever their size there is a limit to the economical rate of piston speed and to the number of revolutions per minute. As the size of the driver increases the center of gravity of the engine is raised. As the steam demands become greater, the difficulty of taking water and firing grows more pronounced. Even now it requires the best work of a fireman when his engine is pulling a heavy load to prevent the engine "dying" on the road, or at least falling far short of its duty. The increase of running speed has been obtained principally by cutting down grades, straightening curves, filling up ravines, replacing wooden structures by permanent way of iron or stone, the use of heavier rails, safer switches, improved methods of signaling, the interlocking of switch and signal system, road-crossing gates, the abolishing of grade crossings; in short, by improvements in detail and management which permit a higher safe speed over a more extended section of road because of greater intrinsic safety, and of the greater degree of confidence inspired in the engine driver, rather than by marked advance in the speed capacity, which should not be confounded with the pulling capacity of the engine *per se*.

With respect to the electric motors the question is not now, can a motor of sufficient capacity be built, or efficiently and positively controlled, but rather how can the electricity be produced and supplied to the motor and at what potential can we work. We all hope to see the time when electricity can be produced economically from coal without the intervention of engines or dynamos; and it may be that something akin to the present steam practice will be common; but I think that even then it will be quite likely that a central station method of distribution will be the more advantageous. On the other hand, there are those who hope to see the storage battery so reduced in weight and improved in other particulars as to warrant its use in a large way in locomotives. For myself, I prefer to consider the possibilities of another method, the amplification and development to its full capacity of present street railway practice, and for that purpose I will briefly consider a suppositious case, namely, an express between New York, or rather, Jersey City, and Philadelphia. But before considering this problem let me point out a feature or two about steam roads. When first laid through a new country they usually consist of a single track which must do the manifold duty of providing for through and local freights, and local and express passenger traffic in both directions. with what success those who are called upon to travel in new countries are well acquainted. The route of such a road is determined mainly with the idea of getting from one place to another by a more or less direct line, but especially by one which shall not require too costly construction. Once determined, new towns spring up along the line of the road, and old towns grow until the demands of traffic make a double track necessary, and as civilization grows apace the freight traffic demands a track by itself and four tracks constitute the equipment. So, following the development of the road, we will find that in time the express and local passenger trains may require individual tracks and a six-track road will be a necessity. But it must be borne in mind that the express is not intended to cater to local travel, but its route is subordinated both in the matter of curves, grades and crossings to the requirements of the early construction. The highest demands of such a service would require that, independently of the local travel, a through express track should be constructed by the most direct route possible between the principal localities, and every effort made to reduce the curvature and grades as much as possible. No matter how much it costs to build such a road, when the traffic is sufficiently large, it will pay to do it.

Suppose such a road to be an electrical one, and the method of supply to be from one or more central stations, the current being taken by a universally flexible underneath contact from a rod carried above the car, and the return circuit made by means of the rails. This method, using of course a wire instead of a rod, having been almost universally adopted wherever street cars are propelled by electricity, its characteristics are well known. What the structure of the roadbed would be need not here concern us. We might use the standard T rail and roadbed, avoiding as much as possible curves, grades and grade crossings, and the overhead rod can be used simply for supplying the current; or some form of a double or single track road slightly raised above the ordinary level, and with the upper rod forming a steadying and centering cord as well as a current supplyer may be used. These are mechanical questions with which we need not concern ourselves at present. What does concern us, however, as electrical engineers is, whether the cost of copper, the potential required, the losses on the line and the number of stations are such as would be prohibitory.

As regards the potential, other things being satisfactory, whatever pressure is demanded in the interest of economical and effective service will be used, and means will be found, consisting mainly in care of construction, which will make its use for the purposes, and as intended, safe and proper. We have in these matters to face the same questions that we have in the matter of steam pressure, or of railway speed. To accomplish the

larger engineering feats necessary to meet the demands of economy and commerce, we will be governed more by belief in our power to fully subordinate a good servant to our will than by our fears of its vagaries when allowed to become a master.

From 8 a. m. to 9 p. m., a period of thirteen hours, twenty-one regular trains leave the Jersey City station of the Pennsylvania road to run through to Philadelphia, twelve of these make but one or two stops. The balance make more or less stops according to the running schedule. In addition to these there are a number of local trains serving way stations. Taking the through trains only, and allowing an average of say five cars to a train, there are in the thirteen hours about 105 through cars dispatched from Jersey City, or at the rate of one car every 7½ minutes, and of the through trains not making over one or two stops there would be one every 13 minutes. We will suppose an additional express track has been built, leaving the distance about what it is now, say ninety miles, but that the grades have been eased and the worst curves rectified. For the practical purposes of this paper I will consider that the road is level, that the cars are to be dispatched in 2-car units on a perfect block system, and to run through to Philadelphia with not more than one stop, at fixed intervals, and at a high average rate of speed, say sixty miles per hour. In the systems that I would propose, practically that with which I experimented some years ago, slight grades would make little difference in the general result, especially if the grade percentage, if expressed as a whole number did not exceed the quotient of the traction in pounds per ton divided by 20; because when $C=\frac{t}{20}$ where t= traction in pounds per net ton and c= grade percentage expressed as a whole number, the work of traction and of lifting are equal. For example, suppose t=10 pounds and c=½ per cent. and that we had on a double track one unit coming down the grade and the other ascending it, both at the same speed. Then gravity would be supplying just enough power to propel the car on the down grade at a fixed speed, and enough power to supply the lifting and traction work of the other car would have to be supplied, which would be just the amount required to propel both cars on a dead level.

Suppose the grade to exceed the ratio expressed above, then the car on the down grade would have an excess of falling energy, and this could be used in accelerating the speed of the car, or on the brakes, or it could be used by a process of reconversion for the purpose of supplying at short range part of the extra energy required by the ascending train. Just how this can be done is pretty fairly understood by electricians, but I will touch upon it again, because it is a feature of vital importance in determining the matter of motor control in a large system such as we are now considering and because it illustrates one of the most beautiful features of this method of converting energy. No matter whether a machine be used for a motor or a dynamo, whether to convert mechanical energy into electricity or the reverse an armature develops an electric pressure or potential which is dependent upon its speed and the effective strength of the magnetic field in which it is used. If this field is in shunt relation to the armature and in connection with the track circuit, we have by any of the well-known methods a means for independently varying the strength of that field. When such a machine is geared to a car, it can either drive the car, acting as a motor, or be driven as a dynamo, and in connection with any other similarly connected motor, or the central station generators, will form an electrical couple, either of which may be driven by, or drive the apparatus to which it is connected. If the couple thus established is between the motor and the central station dynamo we have at one end a machine driven by a constant speed engine and generating an approximately constant electromotive force, and at the other end a machine of greatly varying speed and with facility for increasing or diminishing the electromotive force which it generates. The result is an electrical differential which will establish a current between the two in one direction or the other according as the pressure developed by the motor is lower or greater than that developed at the generating station. If the pressures are equal no current will pass. If the couple consists of two motors thus connected, then we have two apparatuses each of which is generating a variable electromotive force, and there will be a current between these or not according to their relative electrical pressures. A large system is tied together in the most intimate manner possible. The tracks are cross-connected, the overhead conductors cross-connected, and you would have, in effect, what would correspond to two large planes before which was moving at varying speeds a number of independent units, these two planes kept at a fairly constant potential by means of the generating station. All motors starting running on a level, or ascending a grade, would be requiring currents. All motors running on a down grade with just that velocity which the force of gravity would give them would require no current; and motors running on down grades of greater percentage than is required to give them power for traction, or motors slowing down, would be generating currents to aid in the general supply. No other system of distribution can by any possibility have this very remarkable interchange of energy. When running at a particular speed a slight movement of a regulating handle would make the motor receive from or give to the line currents in any desired quantity. The braking power of a motor thus acting as a generator is very powerful and the most perfect imaginable, because unlike the ordinary methods, the brake does not operate if the wheels stand still, the very essential of the braking operation requiring the wheels to turn. It is a well-known fact that the most effective brakework is when the wheels do not skid upon the track, but when they are turning under the pressure of the brake; and contrary to the ordinary braking practice the energy of the electric train instead of being thrown away in the form of heat and using up our wheels and brakeshoes, can be made useful in the propulsion of other trains. I have tried this method of braking with such a degree of refinement that a heavily loaded car would creep on a down grade at a pace so slow that an egg could be put under the wheels and cracked and removed before the wheel would pass over it.

Having thus touched upon the characteristics such as I would propose for a railway system of this kind, let us resume the consideration of our proposed line between New York and Philadelphia, and try to form some idea of the electrical pressure which would be required, the service which could be demanded, the number of cars which could be handled, the speeds which could be maintained, and the number of stations which would be required to operate the stations. We will assume for the purpose of this investigation an overhead conductor in the form of a solid rod one inch in diameter over each track, or, if you please, a smaller rod over each track and a main conductor making up the equivalent capacity proposed, and a track of equivalent capacity. I take this arbitrary size because it is convenient for the purposes of our calculations and because it falls well within the limit of expenditure which such a system would warrant. For instance the American Bell Telephone company has a line of long distance telephone wires rounding from New York to Boston, a distance of about 300 miles, nearly three and a half times the distance which we are considering. On these poles are about 70 wires each of No. 12 copper. The aggregate area of these conductors is over 800,000 circular mills, and the total weght of copper on this line, which is used simply for telephonic purposes, is about 40 per cent. more than the weight of two copper rods an inch in diameter running from Naw York to Philadelphia. If the investment is a reasonable one in the telephone system, cannot we certainly consider it a reasonable one in that larger field of the transmission of power of which we are now speaking?

As I have stated, of the number of trains which in 13 hours leave Jersey City for Philadelphia, twelve usually make only one or two stops. Allowing 60 cars this would be about one car every thirteen minutes. This interval of thirteen minutes is nearly as short as would be desirable between cars running at an average speed of a mile a minute, no matter how perfect the block system, and it would be necessary, possibly, to run these cars in double car units. We will assume for our purposes the size of a car such as is used on the elevated road of Brooklyn bridge in New York, which would with motor and passengers weigh from twenty to twenty-five tons, or a total of say 50 tons for our unit. The formula to determine the size of conductor for a single transmission of car is

$$CM=\frac{15666\,n\,l}{e\,v\,p}$$

where n=the number of horse power, l the distance in feet, E the potential at the motor, v the fall in potential and p the commercial efficiency of the motor. If we assume the station situated in the middle of the line; that is, at the best point, and the work divided equally at the middle section on each side, then L being the length of line we have the formula:

$$CM=\frac{1566\,NL}{4\,e\,r\,p}$$

This will be practicaly the same if the work is distributed over the entire line.

If more than one station is used then the formula will become

$$M=\frac{15666\,m\,L}{4E\,v\,f\,5^{2}}$$

that is, the size of the conductor would vary inversely as the square of the number of stations, if properly distributed. V may be expressed as a fraction of E, and for practical purposes we will let V=1-9 of E and P such that

$$\frac{15666}{P}=\frac{16800}{}$$

that is P=about 93%. Then we have

$$CM=\frac{37800\,n\,L}{E^{2}\,S^{2}}$$

which may be expressed thus, that the size of the wire varies inversely as the square of the product of the number of stations and the electromotive force.

We may also note that with any fixed size of conductor the electromotive force and the number of stations vary inversely, a somewhat important fact to remember.

We have another formula, one for the power required by a moving car, which is

$$h\,p=\frac{4}{75}w\,m\left(\frac{c+t}{20}\right)$$

where w=the weight in net tons, m the miles per hour, c the percentage of grade expressed as a whole number, and t the traction in pounds per net ton.

As I have stated, we will assume in this formula that c equals zero, a consideration in which I am justified in express service on a road of the character I have outlined, with the relation of grades and traction given, and with the method of braking I have described. Our formula would then become, using 10 lbs. per ton as our average traction,

$$hp=\frac{2}{75}\,w\,m$$

which substituted for n in the distribution formula gives us

$$CM=\frac{1008\,w\,m\,L}{E^{2}\;\;S^{2}}$$

or substituting for L, 5280 d, d being the number of miles between stations,

$$CM=\frac{5322240\,w\,m\,L}{E^{2}\;\;S^{2}}$$

We have assumed for our conductors two rods an inch in diameter, and that the rail has the same resistance. Hence substituting for cm its value 2,000,000, we have

$$E=\frac{2\,66112\,w\,m\,d}{S^{2}}$$

or

$$E=\frac{1.631}{S}\sqrt{w\,m\,d}$$

It will be noted that m, w, and d, that is, number of miles per hour, weight handled, and distance over which operated, are all affected in the same way. Hence with any value of E and S we can vary the relative values of w, m and d so long as we do not disturb the product. That is, we can halve the number of miles and double the speed, or double the distance and halve the running speed, keeping the weight hauled the same, and so on. For the total weight we can substitute the weight of each unit, c, and the number of units, b, thus making the formula

$$E=\frac{1.631}{S}\sqrt{m\,b\,c\,d}$$

For the line proposed d=90, and we have

$$E=\frac{15.56}{S}\sqrt{m\,b\,c}$$

Taking our unit of two cars at 50 tons, the time intervals between them as ten minutes, and 60 miles per hour as the mean speed, we have on the whole system eighteen active units of two cars each, and

$$m\,b\,c=54000$$

which substituted in our formula is

$$e=\frac{3616}{S}$$

which means that with one station in the middle, the potential at the motor farther from the station would be 3616 volts, and near the station one-ninth higher. Can we handle it? Yes, in time, but, perhaps, not yet. Nor is there any necessity for doing so: for if we increase the number of stations and go to a 3-wire, instead of a 2 wire system, making the track the balance circuit, we would have motor potential as expressed by the following table:

Stations.		Motor Potential.	
Number.	Miles apart.	2-wire.	3 wire.
1	—	3616	1808
2	45	1808	904
3	30	1205	603
4	22½	904	452

which last brings us down to ordinary street-car practice, which is only the beginning of what will be done in the effective handling of potentials.

So, after all, it does not seem such a serious electrical problem, and certainly not one to shrink from.

We can in another way illustrate the influence of the position and number of stations and the potential used. Suppose we had a station at Jersey City to supply the entire line as a certain potential over a conductor of the required size. If the station be moved to the center, the weight of copper necessary is only one quarter. Use two stations properly spaced and the weight is quartered again. Double the potential and the weight is further quartered. Now use the 3-wire system and the weight is again quartered. So that by these very simple processes the original weight has been reduced 1-256 of the original.

I do not think I need to point out further the value of a proper determination of electrical values in a problem of this character.

We see then that the suppositious case is well within the range of possibilities. A 60-mile express service every ten minutes instead of 40 to a 45 mile service every hour, would revolutionize travel. Of the comforts of such a mode of travel, I need not speak. That it will in the not very distant future be a fact, I know you all agree with me in hoping for.

DISCUSSION.

MR. ARMSTRONG of Camden, N. J.: I want personally to thank Mr. Sprague for one of the most interesting papers to which I ever listened. The figures that he has given us, the explanations that he has made and the statements throughout his address, have been to me of the most intense interest. I was pleased with the legal position he took. As a lawyer I must commend him as a very good lawyer. Some of the matters he has stated were novel to me in the statement of them, but he stated such general principles, that I had to say I knew it all the time, but didn't think of it.

MR. SPRAGUE: As to the statement of the investigation we have made particularly into the motor power which has been used in central stations, the amount of power used, of course depends upon the amount of traffic, the number of cars run, the schedule, the intervals between the cars, the grades. In fact, there are a great many questions which determine it. But we have very recently had an investigation made on five roads embracing every possible condition, and in a short time those will be published in detail, and the result which will be interesting to you as central station operators, in the amount of operating power, the maximum per car, the minimum of current used. All these figures will be very exact and they will be useful in determining the contracts which are sometimes

entered into between electric railway companies and electric lighting associations.

The cost of the operation of railways, is very much less than we have claimed. Whenever we have asked the railway companies to give us this cost of operating their roads, they reply, "Well when we were in the early stages of this business and it was necessary to bring us to a satisfactory condition of mind to sign a contract, it was different. We find there are a great many elements of economy now we have reached there, and we would be glad if you would keep that element of economy out of sight, and do not publish it broadcast, because we do not want some legislative body to come down on us and say 'Reduce your fares to four cents or sell seven or eight tickets for twenty cents.'" So we have had, commercially speaking, to accede to that request

There will be gradually in many of our cities an amalgamation of the electric light and railway interests. It seems to me that is the natural outcome, and I know that oftentimes the same stockholders are interested in both the electric light and railway companies. I am going to have very soon, in a little town in South Carolina, what I think is the most complete electrical station in the United States. Some associates and myself, being convinced that not only the electric light but the electric railway business was a good thing, from the experience we have had with it in the past two years, got hold of an electric lighting company that was earning a very reasonable dividend on its cost. The company had an electric railway franchise which was exclusive for thirty years, and which had been granted both by municipal and legislative action. It also had the general railroad privileges of condemning public and private property. The rights being exclusive not only in the two towns, but for the vicinity, for thirty years, and there being no railroad there, and there being established an electric light interest there, and there being no gas company, we thought the opportunity was an excellent one to carry out that idea which is always in the minds of electrical people, namely, the consolidating of electrical interests. We not only consolidate the electric part of it, but we consolidate the elements of management and personnel. We have different systems, the arc light system, the incandescent system, the power circuit and the railway circuit, all in the same building and under the same roof of the car sheds, and with all respect to the telephone interest, I think pretty soon we will have the telephone circuit. We are going to run telephone wires on the same poles with the others. We are going to demonstrate that it is quite possible to run a telephone circuit, an electric railway pole line not only in conjunction with it, but in conjunction with electric lights and incandescent lamps. We hope this enterprise will be profitable and that there may be a great many other places in which the same thing can be done.

Professor Eaton of Liberty college: I would like to ask Mr. Sprague if he has any objection to stating what his principal reasons are for his conclusion that the storage battery system will not successfully compete with the overhead or direct wire system?

Mr. Sprague: It is this, the simple reason is that you cannot three times convert energy, at the same economy that you can once. That is the first reason. Secondly, because you cannot carry a dead load of two tons around, unnecessarily, without energy—you cannot carry it around anyway, necessarily or otherwise, without energy. You must carry your storage battery and you cannot get rid of that useless load. It weighs nearly two tons. It weighs as much as thirty-five or forty passengers. It weighs more than your motor equipment; it weighs more than your car body considered by itself; it weighs more than your iron trucks considered by themselves. We have to carry our motors around, we have to carry the trucks, the passengers, and the car bodies; but to carry our storage battery is another thing. There are no storage batteries in existence furthermore whose storage capacity will permit of more than 26 or 30 horse power being taken out of it. If you limit the weight or size of your battery, you reduce its capacity. On grades of eight per cent. and that is about the maximum which the adhesion of the rail will permit, you find a great difficulty; you will use about 30-horse power of mechanical energy, and the motor must develop that. There is no storage battery that you can put on a 16 foot grade to-day, out of which you can take that power for thirty minutes at a time; the capacity is not there. But when you get the overhead line or the underground conductor, provided it is connected with a big engine and a lot of dynamos at the other end, you can demand from that station all your motor can carry. There is no storage battery which a company dare recommend for operation upon a 6 per cent. grade, or that you could run 160, 170 or 180 miles a day. The maximum work of a storage battery per car, per day, is about 80 or possibly 90 miles, and there are very few cars doing that. There are no storage battery cars in the United States that I am aware of, that are working 18, 19 or 20 hours a day, as is the case with the direct system of supply.

I hope, as cordially as any other man can, that the storage battery is going to be a success, but there is no question that its limitations are pretty clearly fixed and that it can never compete with direct sources of supply in capacity. There is no limit to the capacity of the motor or the amount of current you can use from a direct source of supply. There is certainly a well defined narrow limit in the case of the storage battery. I say that with all friendliness to the storage battery, because I am interested financially in one—or rather I should say one is financially interested in me.

C. C. Haskins of Chicago then addressed the convention on the subject of "Prodigality in Economy," as follows:

Prodigality in Economy.

BY C. C. HASKINS.

The cautious man of business, when the dull season comes round, goes carefully over his past record, scans his methods, weighs his successes and failures, and endeavors to so arrange his future as to increase the former, and to the greatest possible extent diminish the latter. If he finds that by a liberal expenditure of energy or money in some particular direction he has made satisfactory advance, he seriously considers whether more extended effort in that direction will not still further aid in the general result for which he is striving; and he as carefully passes by and ignores those plans and efforts which have proved either disastrous or very moderately successful.

There are times and occasions when such retrospective examinations of methods and systems are demanded by circumstances, and—as in religion and politics—a revival seems to be required to bring the record of the past up to the programme of the future, that the one may be used for the improvement of the other, by direct comparison. In such a connection I have thought that possible good might result from canvassing the question whether there has not been in the past, whether there is not now, among the electrical fraternity, an inclination to practice a sort of delusive economy in many directions, a policy, which, to use an old and homely proverb, is "penny wise and pound foolish."

A few years ago, when the arc light was hardly more than a possibility, the fraternity, composed wholly of those whose electrical education had been acquired while handling nothing heavier than a quadruplex telegraph battery, brought such knowledge as then existed to the work. One line that I call to mind was put up with dry cotton-covered wire—magnet wire—and the terminals of the line were carried to ground through the gas and water pipes. It was a commendable job, for the best was done with the knowledge at hand. Truth to tell, it would not have been a very dangerous affair if it had got away entirely, for it was a very small plant, and like many another nursling, quite feeble. It was not long until the owner demanded an improved circuit, and again the best wire in the market was used. A second time the plant was overhauled, and the second wire was not considered good enough, but there was substituted for it the best rubber wires known to the trade. I should add that in each instance the plant, on being overhauled, was increased in size as well as improved in construction.

I once asked the owner of the property if the alterations and improvements in that plant were not very expensive. His answer showed me true economy in coal bills, wear and tear of engine and boiler, increased immunity from danger to person and property, and a better, both brighter and steadier light at less cost, with fewer rebate bills and fewer unpleasant interviews with his patrons.

I have in mind a second plant, where it was deemed wise by the management to purchase everything which could aid in tabulating expenditures, in the more readily handling the work to be done in the dynamo room, in the engine and boiler rooms, and in the office. No inconsiderable amount of money has been expended in the purchase of instruments for procuring the various data. Every pound of coal and every bushel of ashes is weighed, and the results are as carefully kept and as faithfully exact as those of a bank bookkeeper's balance sheet. The performances of the engines and dynamos are duly recorded for every day's run. The lines are measured, not only for insulation, but for copper resistance as well, and a record to the minutest particular is made up daily for the eye of the manager. The most minute leak is thus discovered in time to prevent a great waste, and is repaired before sunset if possible, so that no greater strain is set up when the dynamo is again set in motion. Since the first revolution of that engine there have been paid in repairs—renewals of parts damaged by electricity—less, during over twelve months' constant running, than on many a plant of one-quarter the capacity, is wasted in the item of oil alone.

A plant not unlike the one last mentioned, one in which all these vital matters are recorded daily, and tabulated for the manager's eye, has been cited to me as an example of what may be accomplished by a study of such information. In this plant there are fourteen dynamos in daily use, consuming an average of 1,900 pounds of coal per day. The record shows that of this there is about 15 per cent. waste. The manager shows that he is using four and one-half pounds of coal per horse power hour. And for the engines, shafting, dynamos, etc., one barrel of oil is consumed per month. I would gladly mention names in these cases were it not that my lips have been sealed by parties furnishing the information.

Oils for lubrication are as plenty as blackberries, and 12 cents, 15 cents, 20 cents per gallon has a fascination for him who searches for bargains in oil. An apt illustration of the economy of cheap oil was lately given in a railway publication. According to the writer, on an Ohio road the newly appointed superintendent of motive power learned that the valve oil in use, a mixture of black oil and tallow, costing 32 cents per gallon, was giving an average run of 100 miles per quart. He found, also, that an average of one valve seat per day was being faced at the shop. He ordered an oil used that cost 50c per gallon, which gives an average of 200 miles run per quart, with only five valve seats to face in four months—fifteen valve seats to face in a year, as compared with 365, and half as much oil to do the work of the cheaper lubricant. In other words, 25 cents against 32.

Another case comes more directly in our line. Oils costing 12 to 15 cents were found to answer well enough in an engine and dynamo room, so far as heating was concerned, but no pains were taken to look beyond that effect, until, after a time, it was discovered that the journals had a silvery white instead of the polished, mirror-like appearance they should present. Calipering the shaft showed that with the cheap oil the shaft had worn away more in three months than it should have done, with a proper lubricant, in as many years.

The time wasted in chaffing and canvassing for a bargain in cheaper oils might be more economically used by the purchasing agent in athletic development, to the end that oil fiends and other greasy tramps might better comprehend the words "no admittance," which should ornament the door of every dynamo room. Present company is, of course, always excepted.

As it is true that no man knows more than the rest of the world, so it is true that no one man can do all that is to be done in the various departments of a central plant. But human nature is weak, and the range of human eyesight is limited. It is not by any means seldom that the principal official of the plant endeavors to transact his business from the table of his roll top desk, without ever getting his legs from under it to see personally how matters are progressing. Jones calls and arranges to have half a dozen lights put in his store. The manager orders the superintendent to have it done. The superintendent passes the order to the foreman of construction—from thence it goes to the foreman of a gang, and he gives the order to a couple of his "Indians" to do the work. From the manager down to the foreman of the gang, inclusive, no one knows anything more about that installation than the king of Sandwich Islands. If it goes all right, nothing is heard of it, but if a fire occurs, or some person is injured, the whole fraternity, the electric light and power service of the entire world, has received a black eye which requires months to heal. What is everybody's business in this case should be the business of an inspector.

Different methods of managing plants are illustrated by a couple of centrals not very far from Kansas City. They represent extremes. In one of these there is a general impression that some one has done it himself. The dynamo is in a building which seems rather to have grown under adverse circumstances than to have been constructed intentionally. It stands on posts, the space between these boarded up from the ground to the sills. It has all the advantages to be derived from ventilation, and it is well up from the ground. In one portion of the room stand the engine and boiler, threatening destruction to the establishment by either shaking it down or blowing it up, if one may judge by the second-hand appearance of everything. The line is in excellent keeping with the rest. My informant says the wire lies on roofs and against buildings, and is a constant menace to person and property. Connectors in place of soldered twist joints are so constant as to give the idea of the company's having secured a great bargain by purchasing all some concern had, and the consequence is that the lights are unsteady, weak and blear-eyed, while the dynamo has assumed a sad, unhappy cast of countenance, such as one sometimes meets the day after Christmas. The reason for all this unhappy condition of affairs is found in a false economy; the employment of incompetent engine and dynamo men and other cheap ignorance. The result may be foreseen—the plant for sale.

But a short distance away from this disgrace to the fraternity and the art, there is a successful plant run as it were by a one man power. There are over 100 arc lights, and one of two persons sees individually every one of these each day. The parties are father and son. The dynamos are as thoroughly cleaned as possible every twenty-four hours, and there are no corners for the accumulation of dirt that are not carefully looked to. There is no greasy sawdust under foot, no oiled rags stowed away for spontaneous kindling material. Everything is kept snug, clean and in order throughout the entire plant, and the total amount of repair expenses for one year was merely nominal. This plant is not on the market.

These are no fancy sketches. They are taken from life. I fear the first named case has no representative here—it would be well, perhaps, if it had.

A case of false economy I copy from the *Electrical World* of December 14th, last.

In this instance an electrical engineer, compelled by a railway accident to remain over night in a small town visited the lighting station to kill time, and found a mere lad in charge, who told him the plant had not turned out as profitable as was expected, and the stockholders were growling about the prospects. Inspection of the circuits showed that while they were in excellent order, with the exception of a loosened connection or two, the lights were not giving out their normal brilliancy. Returning to the station, he located the trouble in the boiler room, where he found the grate bars covered with a mass of hardened clinkers, through which but little air could circulate, and which required the most severe exertion to remove, while further examination showed that neither the flues nor the tubes had been properly cleaned for months. All this was remedied the following day, with the result of plenty of steam, good light, and a saving of about one-third the fuel. The writer goes on to say that even this pointed and striking lesson in economy was lost on the directors. The boy was retained and permitted to go right on running the plant in his own feeble way.

In construction there are many points of present saving at the risk, if not the certainty of future loss. It costs much less to use the ordinary porcelain drawer knob for out-of-doors insulation. Yet even with the best insulated cable there is positively no real economy in such construction. Neither should a wooden cleat be made to do service for retaining a cable in position. The former, holding as it does by a single screw, is incapable of sustaining the wire or cable securely, and the repeated replacing and renewing consequent upon the use of these knobs, if the line is kept in proper condition, soon far outbalances the price of glass insulators firmly fixed on iron or wood brackets.

Nor should wires crawling along the face of buildings be fastened to the cornices or water tables. Carried out from the wall by an iron bracket, and attached to glass, two great advantages are gained. There is no contact with the wall, and the window washer cannot stand upon the wires to break the insulation and thus increase the danger of accident, and the possibility of the conductor being reached by occupants of offices or flats is greatly diminished.

The objection to an iron staple over a heavy wire or cable is that sooner or later the weight of the conductor will sag, weakening the insulation, if not cutting it through com-

pletely. The wooden cleat is scarcely better. Experience has shown that upon a line where such cleats are used, the retention of moisture by the wood is almost certain to weaken that point, so that when a ground is developed elsewhere, adding to the strain already existing, the cleat aids materially in the development of the second ground with its consequent unpleasantness.

It costs a little more at the time, but in all such positions the farther we get from the wall or the wood, with air for both ventilation and insulation, the greater the economy in the long run.

No inconsiderable expense is sometimes incurred in covering arc light conductors within a building with a neat and ornamental moulding. It is pretty, but expensive, when, as in an instance where I was a witness after the fact, an unnoticed leak from an imperfect sky-light developed a second ground on a heavy circuit, and the insurance fell short of the damage done. In another instance, where wooden cleats were used to confine a cable in a sidewalk area, grounds were developed in half a dozen places almost simultaneously from a very similar cause, and an expensive piece of conductor was ruined. In the first of these two instances, painting or even bronzing the wire with varnish bronze would have been sufficiently ornamental, and the porcelain knobs could have been treated similarly. In any event, but a few days after a line of wire is run through a room it has ceased to be a nine-day's wonder, and is seldom ever thought of again. So of lines outside. When first placed every one sees them, and all sorts of criticism and comment are the order of the day. In a few days the gossipers have some other target for their witticisms or remarks, and the wires are permitted to rest.

There is one exception to this rule. In the experience of almost every central plant management, there is one individual who says that under no circumstances can any electric light wire pass his premises. He seems to have been born a coward, and nothing on the surface of the footstool can make him brave unless it is one free lamp. The economy here is compulsory, and is not to be questioned.

Is not the unfortunate condition of affairs at the East, with all its concomitant newspaper and magazine literature, its bickerings, injunctions and other legal entanglements, traceable either directly or indirectly to a mistaken economy? Is it not fair to presume that at the outset, with a reasonable expenditure in first-class material, much of the business unhappiness and the mental bitterness which the electrical fraternity and the outer world, metaphorically speaking, have been forced to swallow, would have been spared them? A difference of forty, perhaps fifty dollars per mile of conductor, I believe, would have worked wonders as a peace and harmony panacea, and left fewer raw spots and blisters on the electrical animal to be gradually nursed back to health and vigor. I may be wrong, but I strongly incline to the belief that where the false or dangerous systems of economy have clashed with legal authority, the savings so accumulated are more than balanced by rebates, legal expenses, loss of patrons through stoppages or poor service, or both, in the long run.

Every new industry is compelled to fight for an existence. If, like the electrical enterprise, it must elbow its way into notice, taking the place of a competitor in the front rank, it must make enemies, and of a necessity antagonize those whom it discomforts and crowds to the background. It is not an attribute of the descendants of Adam to submit tamely to rebuffs and usurpation, and no opportunity is ever lost of disfiguring the countenance of the new-comer. To give occasion for and encourage these opportunities by our own acts seems to me to be short-sighted and illogical.

It is true that electric lighting and power have made wonderful and monstrous strides in popularity, considering the youth of their existence, and they will continue, despite every opposition, to grow in grace and strength, till they have relegated to the rear ranks every other form of illumination, and crowded the present clumsy, hot, ungainly engines from their vantage ground, as the circus elephant clears the tanbark ring for the riders. But the public has some voice in the matter, and the higher the standard of excellence to which the electric light and power man brings his work, the more rapidly will the circle of usefulness widen and the more tranquil will his enemies have become.

The parties in whose interest legislation on the installation and use of electricity for illumination was first invoked were unwittingly chargeable for the many set backs and the want of progress which checked the enterprise in its early days, and are not wholly free from blame, though indirectly, for the present troubles. These were the fire insurance people. These men deal only with combustion. There is to them a magic in the word incombustible. Say fire proof to an underwriter, and his heart leaps with joy. It was a sharp trader who exhibited a cotton-covered, painted wire to the insurance people and demonstrated that it did not readily burn. "Just the thing," said the actuary, and the president, and the inspector, and they all smiled at the honor conferred when the cunning merchant baptized it for its godfathers, and called it "The Underwriters' Wire." There is a class of hard citizens who usually have an alias. The underwriters' wire is to-day best known by its nickname.

Another misfortune has been handed down to us from the early days of electrical illumination, which I look upon as one of the original sins of the business,—the magneto bell. I have written and scolded and begged to have this abomination sent out of the realm, but like Banquo's ghost, it will not down. I find it everywhere, and if I ask the party in charge of a plant what his insulation is, I am quite often told that it is "first-class, my bell won't ring no matter how fast I turn it." A short time ago I took occasion to measure the resistance through which I could ring the bell of one of these guaranteed for 15,000 ohms. With a really smart grinder, we did manage to get a slight response through 6,500 ohms, and when I included the manager with the first class line he claimed to have, and turned the magneto crank, the effect was marvelous. He made several florid remarks on the occasion, and bought a bridge set the next day. He has since told me repeatedly, that the investment has paid him several times over in line economy.

A magneto has no method of giving information beyond the fact that there is or is not a bad condition of affairs on the line. If there are two or more faults, there is no possible way of distinguishing when the linemen have found one of these, except in a negative sort of manner. So soon as the insulation is raised to a point where the bell refuses to ring, its maximum of usefulness is reached. Take the case of the line just mentioned. A maximum insulation of less than 6,000 ohms' resistance would be the best that instrument would show. The waste of current, the unsatisfactory lights both as to brilliancy and steadiness, the useless labor of the generator, the coal waste, the danger to life and property, all those faults which follow in the wake of such weak insulation, certainly confer no honor on an economy which persists in using an instrument that can virtually do no more than show up a dead ground.

Nor is it any better as a method of testing the insulation of fields and armatures. It is far more potent for mischief than is generally suspected, for the spark generated is of very high tension, and is quite likely to cut across and open the way for a short circuit when next the machine is used, by weakening the insulation.

And again, the magneto being the sole dependence of the station the services of an expert are far more often required than they otherwise would be, while the vexatious delay the annoyance, and afterwards the bill which seems outrageous, cannot be placed to the credit of the economy account. Yet the magneto seems almost as persistent and hereditary as John Calvin believed original sin to be.

The dynamo man and the engineer, when these are two, are often refused, on the score of expense, the most reasonable demands. A case which struck me quite forcibly, I may mention, to illustrate my meaning. The attendant at a plant found that a portion of the paper driving pulley was becoming loosened, and that in order to restore it to its normal condition he needed a peculiar form of wrench. The manager was notified, but refused to allow the purchase, although the sum required was but a few cents. He said the company could not afford it, and the engineer must get along the best he could. He did the best he could, and so did the pulley. It went to pieces. The dynamo belt went into the engine governor gearing, and the entire plant had a three days' vacation. The lost time, rebates and repairs bills, would have paid for several bushels of such wrenches as were needed to repair the pulley.

There are other and many simple, but necessary appurtenances of use and convenience, too often refused on the score of economy, which repay the original investment many times over during their existence.

Coupling up high potential dynamos in series to save wire is doubtful economy, to say the least. Insulation is subject to damage from within as well as from without, and two lines of thirty lamps each will last longer and pay better than one with sixty lamps run by two 30-light dynamos in series.

When renewing the belting of a plant is sometimes a matter of considerable anxiety, occasionally the desire to get a few more days' service out of an old one involves possibilities which may be extremely hazardous. The chances in case of a break, of the belt becoming playful and familiar, always suggest to me that belts are like oil paintings—made to look at, not to smell of. Yet many a belt has been thrown away as useless because of its having become accidentally greased to that extent that it refused to hug the pulleys. This may be remedied by covering the driving pulley with a leather band, the width of its face, fastened on with counter sunk bolts. In a comparatively short time the belt, provided it is not again greased, will, by centrifugal force, and evaporation, rid itself of the oil, and wear to a good old age.

There is excellent economy in the encouragement of the expert and his assistants, who are, when worthy, the prime support and king-bolt of the business. The hours of such an employe are almost undefined—undefinable. He is, perhaps, taxed beyond his endurance, and many such a man has been lost to his employer through attempted economy in riding a free horse too hard.

It is, however, no trouble to supply the place of one who desires to leave a situation. The woods are full of electrical shoddy, and there are plenty of men who claim the title of electrical engineers and sport a card showing them to be both mechanical and electrical experts. They generally have a place—they call it a position—where a plant is run on an assumed economical basis. Usually these do not last longer than to have made themselves unduly expensive to their employers.

Outside men, too, are often weighed in the balance and found wanting. It is competent for an employe in electrical work to do almost irreparable mischief, and yet not be aware of the fact. There is no gauge by which his claims to knowledge and experience can be measured, except by trying him. The only way I can see to govern this difficulty is to put a thoroughly competent, reliable man over the bell-hanger and shoemaker electricians, to watch and discharge them. The watchful eye of a high-priced man for foreman or superintendent has saved many a dollar to the contractor, which would otherwise have been paid after the plant was supposed to be finished, and before it was accepted.

An extraordinary demand for labor always brings to the front a class of men as unskilled as it is unscrupulous—men who never get up to their maximum of speed until about supper time. Practical electricity is suffering to-day from the wisdom of men who talk learnedly of "galvanometers" and "computators" and seem to think that an insulator, like a tumbler, is most likely to be of some service when placed with the open end up.

Yet, the theoretical without the practical ability and education, is no better. It would be poor economy indeed to depend solely on what the expert may have learned in books or at the institute. Two cases contrasted will illustrate my position.

A young man who is at present in a position of considerable importance, in addition to small amount of education theoretically, had combined with this a practical experience in handling circuits and dynamos. A combination of circumstances, such as you all know by experience, called all the experts away from the job—which was a new plant of considerable pretensions—just as it was about ready to run. The engines were started, but soon after the lights were switched in, the dynamo showed an imperfection which rendered it utterly useless. The time for the grand opening was fast approaching, and there was no other dynamo to be had there, while the factory was so far away that to get one was impossible. The trouble lay in the fact that the centrifugal force of the armature had thrown the insulation between the commutator sections out just far enough so that the brushes touched only occasionally. With a very fine file he dressed down the projections, and with another tool, improvised from a second file which he ground down, he burred the edges of the sections to prevent a recurrence of the trouble, started his machine and made the opening run with perfect success, and ate his supper the next morning. That kind of a man is a jewel at any price.

A contrast to this is a case where the hero is a graduate of an Eastern college, who has himself been a teacher, but he is only a book electrician. The construction of a central plant has been placed in his hands, he being the electrician of the locality, which is situated in one of the Northern States. Reasoning, apparently, that a wire which is covered with a material which the books he studied said was an insulator, that should settle the question, and consequently he said in effect: "No glass or porcelain can be necessary. To purchase these will cost more than staples, so we will use staples." If the fire department and the underwriters keep hands off until that plant is fully under way, there will possibly be some fun right near home.

The day of dark, dingy, unhealthy and damp dynamo rooms, with their dangerous surroundings, is fortunately fast passing away. The false economy which induced the selection of such sites has become self-apparent. It has become the rule to prefer clean, light and airy rooms, and an occasional crank on the subject has even gone to the extent of kalsomining and painting the walls, timbers and ceiling. The great advantage, however, in the latter day dynamo room, is the safety which comes of distance from the ground. I look upon the omission, in these days of progress, of any possible safeguard against danger to property or person, as criminal, as contrary to the principles of true economy and extremely impolitic. The public is not near-sighted, nor is it either tongue-tied or weak in the lungs.

There is an expense attending the change of a circuit or the removal of one, often a no inconsiderable expense, the saving of which may not always be true economy. I refer to the common habit of allowing wires to remain after the change is made, and thus become "tramps"—homeless wires. These vagabonds, whether of No. 6 underwriter or No. 18 annunciator, are capable, like other tramps, of unlimited and incalculable mischief. It is not directly in the power of the electric light man to control the telephone and telegraph and ticker people, but he can, and should, for his own good, gather up the remnants of discontinued circuits and clear himself as far as possible from chance of blame. The public jumps at conclusions, and right or wrong, there must be a cause given at once for every abnormal condition of affairs, every untoward circumstance, or otherwise the people's greedy appetite for sensation is unsatisfied.

It is questionable if more is not lost than gained by running incandescent lamps above their proper pressure, with the idea of obtaining more light. The increased light thus obtained is indeed great, proportioned to the increased pressure, but the life of the lamp is alarmingly shortened. It is better to run a volt or two below than a volt above normal pressure.

It is false economy to purchase cheap lamps, which consume more current in the production of standard candle power, rather than to buy lamps of higher efficiency at more advanced figures. In addition to the fact that an efficient lamp is an able economic lieutenant to the coal pile, the sizes of wires needed may be less, other things equal, with an efficient lamp. And, of course, as a natural consequence, more lamps may be used to a given number of square millimeters of conductor, and more lamps can be run from the same generator.

Cheap lamps too often go upon the same circuits as the better ones, and want of uniformity of voltage throughout the plant is the natural and unfortunate result. This condition, of course, is only found on isolated plants, but it is worth considering as an argument against the peddler of inferior merchandise. Inferior lamps are poorly constructed, the candle power and voltage are not measured by proper instruments and methods, but are guessed at by the eye, and no two consecutive lamps are similar as to candle power under the same pressure.

In connection with the matter of lamps, a method of keeping track of lamp renewals has been shown me, which is claimed to be giving excellent results. The plant where this plan was inaugurated is one of magnificent distances—some three miles separating the extremes of the territory occupied. The company's contract with its patrons is to renew only such lamps as have burned out. All broken globes are paid for by the patrons. The company places at regular stations—usually in drugstores—a few lamps, with a blank, ruled for particulars as to size, price, date, etc., and a receipt to the custodian, for lamps delivered. The depositories are visited weekly and settlements made.

The advantages of this plan must be apparent to all. The consumer buys his lamps as he needs, without having either to go far, or keep a considerable number on hand, and the managers are enabled to discover a weak spot in the system if the breakage is excessive at some par-

ticular locality. This plan has been in operation something over a year, with the most satisfactory results to all parties concerned.

In conclusion, the prosecution of electrical enterprises is like that of almost any other business, and will be most successful when based on and conducted with true, proven economy, when the most approved appliances and materials are used, and the best ability in each department is employed. An incompetent fireman is a very expensive luxury, a careless lineman is a drain which saps the profit account of its treasury, while a dynamo man or an engineer who watches the clock more closely than he does the gauges or the brushes, is sure to be a heavy brake on the wheels of progress.

But where all the little army is striving, each individual with his own ability, to aid in the general success of the undertaking, when each feels that he possesses the confidence of his superiors and that appreciation of his efforts is a stepping-stone to preferment, the current of success flows more evenly, the resistance which generates wasteful heat disappears, and the field of personal magnetism is strengthened and extended, until it permeates the entire organization

Charles A. Harber of Kansas City, read a paper on line insulation as follows:

Line Insulation from the Standpoint of Practical Experience.

BY CHARLES A. HARBER.

The question of the day for electrical industries is insulation, and believing that any information bearing thereon, and derived from experience, may be valuable, I present a brief record of measurements to determine the relative resistance of several forms of insulation.

In what follows I lay before you the results of daily measurements made in the interests of the company whose central stations I have in charge; but I assume to draw no conclusions save the urgent need of constant vigilance. It being my object to draw out rather than exhaust discussion, I leave to others the matters of proper construction, inspection, etc., all of which are equally important.

During the last 24 months I have personally tested the insulation of our circuits. The instrument used is the Electrical Supply company's standard testing set, composed of a silver battery of 24 cells and combination of Wheatstone's bridges with galvanometer and variable resistance. I have measures from 1-100 to 1,111,000 ohms. Measurements are taken shortly before closing circuits, first the precaution being taken, however, to ascertain if the circuits to be tested are crossed by live wires; which if not producing sufficient current to endanger the instrument might give an incorrect reading.

These measurements are then averaged daily and also for the month.

It should be borne in mind that the measurements are limited to the capacity of the instrument used; this, however, is a matter of minor importance as the value of insulation in practical work depends not on its highest, but on its lowest resistance.

Among our circuits operating Thomson-Houston arc lamps (about 10 amperes at 50 volts) we have four covered respectively by P. & B., simplex, Grimshaw and okonite.

The external conditions of these circuits are nearly the same. The okonite circuit in use 18 months, is 2½ miles long and operates 50 lamps, the P. & B. circuit in use 15 months, is 2⅞ miles long, and operates 40 lamps; The Grimshaw circuit in use 18 months, is 2 1-15 miles long and on it are 24 lamps: The simplex circuit in use 13 months, is 3 7-10 miles long and operates 40 lamps.

During the 12 months ended January 1, 1890, measurements of insulation of these circuits have averaged: P. & B. 485,702 ohms; Grimshaw 891,392 ohms; simplex 895,122 ohms; okonite 900,212 ohms.

The average lowest resistance for the 12 months is as follows: P. & B 35,200 ohms; Grimshaw 160,400 ohms; simplex 163,871 ohms; okonite 172,913 ohms.

Loss of service during the year directly attributable to grounds, is on the P. & B. 301 lamp-hours; Grimshaw, Simplex and okonite, none.

J. E. Lockwood of Detroit, then read the following paper:

How to Make Arc Light Circuits Safe.

BY J. E. LOCKWOOD.

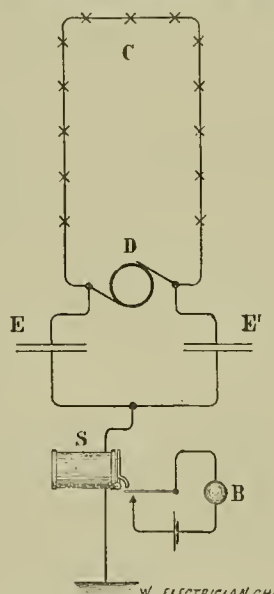
I come before you to-day to speak upon a subject which I am satisfied is of such importance as warrants a very careful investigation, and I am satisfied that if we make it in a thorough manner and then apply it to the best of our ability, by the knowledge thus gained, we will have done more toward ending the cry of the press and people about the dangers of electric lighting, than could possibly be done in any other manner.

The subject of my paper is, "How to Make Arc Light Circuits Safe." Now, I do not mean to convey the idea that arc light circuits are not, and will not always be dangerous, under certain circumstances, but I mean that with our present knowledge and with the application that can now be obtained to enable us to apply the same, we can make our arc circuits so safe to our employes and the general public, that accidents will be of such rare occurrence as to attract no adverse criticism from either the press or the people.

We all know that the past year has been productive of more harm to electrical interests than any other year since we started, and there is no gainsaying the fact that *all* the results of accidents are from arc lights, such as are usually termed "high tension circuits"; for although there have been a few accidents due to other causes, they of themselves would have caused no comment. Let us then benefit by the lesson we have had, and from this time forth see that nothing is left undone to prevent a recurrence.

Now the first thing to do is to locate the causes of dangers and troubles, and then next to show a way to avoid them. As to the cause, we all know that the prime cause in almost every instance is a grounded circuit, and though there are other things to guard against, I think that if we can effectually guard against grounds, or to almost the same end, be sure that the instant a ground appears, that fact will be known, and the ground located so that it can be quickly removed, the other causes will not be likely to result in much trouble. This can be more properly and effectually taken care of by issuing good and complete instructions to our employes, and then seeing that they are enforced, than by means of appliances at our stations. Now, to avoid the dangers resulting from grounds, we must first provide some means or system to enable us to know where a "ground" comes onto a circuit. It has been suggested to make a permanent ground in each circuit through a high resistance with an annunciator drop in circuit, so that when a second ground occurs a portion of the current will be shunted through the high resistance and drop and thus cause the drop to fall and indicate the coming on of the ground. An apt suggestion in regard to trying these devices has been made, viz.: that before asking others to try it, the inventor should be first connected to a high tension arc circuit and then make the second ground through his body. If this suggestion is carried out, I do not think this particular inventor will bother us any more

Many other ideas have been advanced and schemes tried to accomplish this result, but to-day I know of but one system that will automatically indicate a ground the instant it appears on a circuit, and that of itself creates no danger. This is the Rudd ground alarm, the invention of Professor Rudd of the Western Electric company of Chicago, and it is in use at the station of the



RUDD GROUND ALARM

Chicago Arc Light & Power company, and I believe at a few other places. The Rudd system is as follows, the description and cut being taken from the Western Electrician of August 24, 1889).

(Continuing, Mr. Lockwood said, reading from the Western Electrician:)

"Referring to the diagram, *D* represents the dynamo; *C* the circuit of lamps; *E* and *E'* condensers; *S* a telephone drop; *B* a vibrating bell. It will be observed that the bell is worked by one cell of battery, and the bell circuit is closed when the shutter of the telephone drop falls. The details of the drop are not shown, but they are the same as those which are found in ordinary telephone work. The shutter is held by a catch which is lifted when the magnet is actuated. When the catch is lifted the shutter falls by its own weight, and thus closes the bell circuit. The drop is operated by current from the dynamo in the following manner: One pole of condenser *E* is attached to one pole of the dynamo, and one pole of the condenser *E'* is attached to the opposite pole of the dynamo. Thus a free pole is left in each condenser. These free poles are joined together and take a common path to the ground through the drop *S*. In using the apparatus the shutter may fall at the same time of connecting up, on account of the static capacity of the circuit, but this fall may be ignored and the shutter be set back again. The legitimate fall of the shutter will take place upon a sudden disturbance of the insulation of the circuit, if the disturbance is marked and confined to a small portion of the circuit, as is the case when a ground comes on. While the insulation of the circuit remains as it was when the apparatus was set, the conductors do not permit any appreciable passage of current. By the use of this device instant notice will be received of the coming on of a ground and valuable time may be saved in the matter of removing it."

It will be seen from the diagram and description that this device does not ground the circuit, but acts from the static effect due to a disturbance in the insulation of the circuit. In applying this device switches are introduced at *A* and *A'*, so that in the event of two or more circuits being connected together, only two condensers are left connected, and those are the two that represent the two terminals of circuits to which the dynamo is directly connected.

If this system is used a ground will be indicated the instant it appears, and we then have before us the problem of locating it. If, however, the above system is not adopted, the next best thing to do is to test every circuit regularly each day at certain specified hours, and I should advise a test every two or three hours while the circuit is in operation and two tests while not, the last two to be made, one the first thing in the morning, the other just at a sufficient time before starting up to give time to remove the ground if one is found to exist If any circuits are operated all the time or nearly so, all four tests should be made while in operation at regular intervals.

As a result of my experience and observations, I believe that the majority of grounds occur while circuits are in operation and that the best time to test for the same is at this time. In most cities there are many circuits that never have all their loops thrown on except when the circuits are in operation, and therefore this is the only time when the circuits can be tested in their entirety. To make these tests would require appliances to test both live and dead circuits, or in other words, circuits in operation and circuits not in operation. For the first or live circuits I would advise the use of any of the appliances which I will describe further on, that can be used to locate the grounds. For the second, or "dead" circuit, I would advise any of the testing sets now made by electrical instrument manufacturers, which are a combination of rheostat and galvanometer on the Wheatstone bridge principle, and which will test satisfactorily up to at least one megohm. A brass plate at the switchboard should then be provided and the same connected well with the earth. Now, by connecting one wire from your testing set to this ground plate and the other to a terminal of a circuit, your circuit and the earth become portions of the circuit and the ground connection between those two can then be measured. The total resistance less the resistance of the portion of the circuit between the set and the ground will be the resistance of the ground connection. No connection of less resistance than 100,000 ohms should ever be allowed to exist, and preferably not less than one megohm.

We now come to the locating of grounds when they are found to exist, and we will first take up grounds on dead circuits. To carry out this work we need the combined galvanometer and rheostat already spoken of, and the principle upon which the same should be applied is to divide your circuit into two parts by means of a cut-out box provided for this purpose or other convenient means and then to find upon which of these two parts the ground exists After having determined this we can then connect the two parts of the circuit together and test next from a point about midway in the part upon which the ground exists, first separating the portion of the circuit leading to where the first test was made from that portion leading beyond this point; if the ground is still beyond this point, we must close the circuit here and again open it farther on and thus finally locate the ground. But if the ground is located on the portion of the circuit leading to where the first test was made we then know the ground to be between that point and the point where we are now testing We can thus by dividing and subdividing the circuit locate the exact portion upon which the ground exists. As an adjunct to the foregoing, and as a convenient means of cutting the current off from a portion of the circuit without affecting the whole as is sometimes necessary on account of a fire, it is advisable to divide each circuit up into four or more sections and to provide cut-out boxes so that any one or more of these sections can be cut entirely out of circuit.

In testing for grounds each section could then be tested separately and thus locate that upon which the ground exists so that if necessary all of the circuit but the grounded section could be started up and then as soon as the ground is removed this section could be cut in.

In addition to providing these cut-out boxes loop circuits only should be put up, their advantages being too well known to need any explanation.

We now come to the locating of grounds upon live circuits. I will first describe the system used by Mr Law in Philadelphia, it being the same as I have used in testing high voltages for the last three years and, if I make any errors I trust Mr. Law will correct them. The principle of this system is that high voltages can be easily tested with ordinary appliances, such as incandescent lamps and ordinary voltmeters, if we test by steps To do which as many incandescent lamps of as nearly as possible a uniform resistance should be connected in series as there are are lamps on the longest circuit to be tested. If, then, this series of incandescent lamps be connected across the terminal of the dynamo or circuit where the greatest difference of potential exists, as the incandescent lamps are connected in series and as there are as many as there are are lamps on the circuit, each incandescent lamp will get the same number of volts as each are lamp. Mr. Law states that he prefers using incandescent lamps of as nearly as possible the same voltage as his are lamps, say of from 45 to 50 volts, so that when they burn at their normal candle power he will know that they are each getting the same number of volts as his are lamps average. Now, before going farther, I wish to explain that as the current leaves the positive terminal of the dynamo it is at its maximum voltage, which we will call 3,000 volts, and that as it passes through each are lamp and is lowered at an average of about 50 volts per lamp, we have only to find the voltage of the current at the point of the circuit where the ground exists and then to divide the

difference between the maximum voltage and the voltage at this point by the average voltage per arc lamp to find how many lamps are between the ground and the end of the circuit at which the test is being made. If, then, we have a list of the lights on this circuit arranged in the order in which they are connected, and stating which is the positive and which the negative end of the circuit we have only then to count off the lights and thus locate the ground.

This is substantially what is done by Mr. Law, with the simple difference that as he has means for cutting down the number of incandescent lamps in the series, he therefore connects one end of the series to a ground plate and the other to one end of a circuit, and if there is any indication of a ground, he then cuts down the number of incandescent lamps in the series until those left in the circuit burn at their normal candle power. A number of these then correspond to the number of arc lights between the end of the circuit from which the test is being made, and the ground to prove the test from the other end of this circuit, and then he adds to the result of his first test the result of his second one, and their sum should equal the number of arc lights on the circuit. If, however, the number comes short he adds half the shortage to the result of each test, and thus locates the ground. The ground having been located it simply remains to send a competent man to examine the circuit at this point and to discover and remove the cause.

My objection to this system of testing is based upon two reasons, first, because low voltage incandescent lamps are used that take about one and one-fourth amperes to bring up to normal candle power, and thus create a danger by the liability of this amount of current when passing through a light ground to cause fire, and the possibility of accident to persons who may come in contact with the circuit, being tested at a point far enough removed from the end at which the test is being made to cause serious results. What we want is to remove all the danger we can, not add new ones.

My second objection is based upon the very point wherein Mr. Law finds his system does not work satisfactorily, viz., that his system is not suitable to locate a weak or high resistance ground. When we want to make any certain resistance that may be in series with other resistances as small a factor as possible of the whole, we use high resistances for the others, not low ones, such as low voltage lamps. Even 60 lamps of a voltage of about 50 would only have hot a resistance each of about 40 ohms or less, which would only make a total resistance of about 2,400 ohms, and as to make the test it is necessary to have these lamps or a portion of them up to candle power, we can see that the highest possible ground resistance that could be tested would be by ohm's law, which, in this case, will be 3,000 divided by 1¼, which would give us 2,400 ohms, the highest resistance ground that we could test.

Now we should at least be able to test up to 100,000 ohms, and as with a voltage of 3,000 we could only get a current through this high resistance equal to 3,000, divided by 100,000, we could thus only get three one-hundredths of one ampere, and we could consequently use a system that could be operated by this amount of current. Now, to make our ground the least factor in the test, and as we would have only about one-half our incandescent lamps or high resistance coils in circuit in most tests, we must use resistance coils, and make them of such a resistance that 30 will equal at least one megohm, and thus each one would be about 33,000 ohms As this high resistance is necessary to apply this system satisfactorily, you can all see plainly why I do not approve of the incandescent lamp system. If, however, incandescent lamps are used for ground testings only, those of the highest possible resistance and that use the smallest fraction of an ampere are suitable, and of all the styles now on the market the 8 candle power 110-volt lamp is the most suitable, because if, as many of these lamps are used as there are arc lamps in circuit, they will each only get about 50 volts, and consequently about one-tenth of one ampere, and will thus enable us to test up to a certain resistance equal to the maximum voltage of our circuit, say 3,000 volts, divided by the amperage, one-tenth of an ampere, which would be 30,000 ohms, a great increase in range from the low resistance lamps, which only enabled us to test up to 2,400 ohms. If lamps are used we should also use a dead-beat volt-meter, such as is made by the Weston Electrical Instrument company, and should be connected in shunt around the first lamp of the series, which should be of enough higher resistance than the rest of the series to make it a resistance when connected in multiple with the volt-meter just equal to that of each of the other lamps of the series. We could then, when making our test, cut out of circuit the incandescent lamps until the volt-meter indicated as nearly as possible the voltage which our arc lamps average. The number of incandescent lamps still remaining in circuit would then correspond to the number of arc lamps between the end of the circuit being tested and the ground. I would much prefer thus using a volt-meter and high resistance lamps to using low resistance lamps and bringing them up to normal candle power. This outfit could also be used, to find the average voltage of arc lamps on any circuit and having once determined this point and also how many lamps the line is equal to, and then test and find out at any moment how many lamps are being used on any circuit, and, if we are running a number of circuits from one dynamo, we could then find how many lamps are burning on each circuit, and plan our changes and combinations understandingly. A great improvement on this system would be a voltmeter to read up to five or six thousand volts, such as Mr. Law says can be made by the Weston Electrical Instrument Co., and the amount of the improvement would depend entirely upon the fraction of an ampere used to operate this instrument. The smaller the fraction the greater the improvement. With such an instrument the coming on suddenly of a ground when a test is being made, even if at the opposite extreme of the circuit, would do no harm to the instrument. This instrument should be as nearly as possible dead beat, so that in testing for a swinging ground the instrument would indicate accurately the voltage at the ground, even if the connection only existed for a moment. We now come to a system of testing which I think a great improvement over those already mentioned, except in one particular, viz.: the testing for swinging grounds. For this purpose the extremely high resistance and high capacity, dead beat volt-meter I consider better than anything else. This new system I had the fond belief up to a few days ago to be original with myself, but I find the old saying, that "there is nothing new under the sun," has been again exemplified by my finding that practically the same system is in use at the stations of the Arc Light & Power company in Chicago, it having been put in, I understand, by Professor Rudd of the Western Electric company of that city. The system in brief, is similar to the Wheatstone bridge, as the principle is to form a shunt circuit between the terminals of the arc circuit by means of from 60 to 100 coils of high resistance connected in series, and then by means of any very high resistance galvanometer finding the point on the shunt circuit from which no current will flow to grounds, then by noting at what point on the shunt or testing circuit for which this neutral point is the ground, it can easily be located. In applying this system I would provide means for cutting out of circuit any number of these coils with the idea of using at each test only as many coils as there are arc lamps burning on the circuit at the time of the test. Then when the neutral point is found you can see at once, without figuring, between what lamps on your circuit the ground exists. The advantages of this system are: First, it creates no new dangers; second, the question of how high a resistance ground can be tested depends simply upon the sensitiveness of the galvanometer; third, it is quick and accurate and cannot be damaged by grounds suddenly coming on when testing. Now, as a necessary adjunct to any of these systems of testing, there should be prepared a list of the lights and service on each circuit arranged in the order in which they are connected in the circuit, and stating which is the positive and which the negative end of the circuit. With such lists a competent lineman, when notified that there is a ground so many lamps distant from the negative or positive end, as it may be, of a certain circuit, should have no difficulty in quickly locating them, and to enable him to safely and quickly do this, he should be provided with a high reading volt-meter, so that by going directly to the point where he thinks the ground exists and testing from the circuit of the ground with his volt meter he could tell whether the ground was very near or not, and if not, about how many lamps were between this point and the ground. Then by testing again a little further on he would immediately see whether he was approaching or leaving the ground, and thus could quickly locate same. In conclusion I would say that I firmly believe that if we use such a system of testing as last mentioned and equip our circuits with good lighting arresters, and some such device as the circuit openers lately brought out to disconnect the dynamo from the circuit when the current ceases for an instant through the breakage of a wire or any other cause, and then see that our employes use these appliances and do their utmost to keep all lines clear of grounds we will have few accidents, and the press will have little or nothing more to say about the dangers of electricity.

DISCUSSION.

M. D. Law of Philadelphia: I have listened with great interest to the reading of the paper presented by Mr. Lockwood, and I have been especially interested in that part of it relating to the central station work. The explanation that I gave of testing for grounds is one of the first that has ever been presented to the association. It is a very good method, but still probably not as good as the one that you have just listened to. It is a method that lies within the reach of all. My reason for using a low voltage lamp was simply because it was easier to locate the ground, and in the undemonstrated way in which we were doing it, it was easier for the men that were in charge of the station at that time to grasp the idea. I use at the present time a simple method of diagrams which might be interesting to some of you. I print a sheet of paper which is, I think, about twenty inches square, and is ruled in red lines one half an inch apart. These lines are marked up, by the streets, both north and south, in the section or territory through which a certain circuit will pass. In constructing that wire we started out on these red lines and followed them by corners and routes, the entire length of the circuit, marking at the terminal or station end the positive and negative side of that circuit. At the present time I am keeping the locations of lamps on that circuit simply by a lead pencil, that they may be easily erased and changed. I have a blank, called a line report, which I require my foreman of lines to hand in, with the complete report of the condition and changes in lines from day to day. As that comes in to my desk it is very easy to rectify any changes that have been made upon that circuit.

Mr. Brophy: I believe any system of testing grounds on an arc light circuit, by a low voltage resistance in the circuit of the ground, is dangerous. The plumber and the gas-fitter, those worthy individuals who are a terror to all electric light men, get in their work, and an imperfect ground is established possibly between a gas pipe and an arc light circuit. It is desirable in testing to reduce the amount of current traveling over that part to the lowest possible amount. In addition to having a proper method of testing and clearing the line of the ground another very good thing to do is to clear your lines of everything in the shape of obstructions. There may be a wire run by a boy who has set up a bell somewhere, and whose fond parents believe he knows everything about electricity. Do not enter into any arrangement by which any grounded circuit can be run on your own poles and fixtures.

Charles E. Gregory of Chicago: We are running 300 arc lights in Chicago. We have our chief linemen go over that circuit and see every foot of it at least once or twice a month. We use the galvanometer to take our measurements by. We think by going over it frequently the linemen can oftentimes see defects and observe repairs which can be made in the line where they would not be affected until a storm occurs. In that way out of seven circuits, for a period of over seven months, we have had no occasion to shut down for any line trouble. We haven't any newly devised schemes for locating grounds. Our circuits are all underground, running through alleyways. We measure from one side of the street to the intersection of another. We occasionally pull those wires up, fix them and put them back again. In that way we save a great deal of trouble. We have no air circuits at all, except where we come out of the alleyways. We come out and run into a building, and if it is only one or two numbers on the street we go right back into the alleyways. We think we have saved a good deal of money in that system Any indication of trouble is readily discovered, and we at once send a man who removes it.

Mr. Lockwood: I omitted one point in my paper. After we have put up our lines in the best manner we know how with our present knowledge, and equip them with the best appliances we can get, using those appliances in the best way, we should keep a record of our knowledge of the grounds and their causes; and after a short time in studying those causes I think it will be found where we can improve upon our method of construction

Mr. Law: In reply to Mr. Lockwood I will say that I have prepared for my ground testing a sheet on which a report is kept of every two-hour test made during the day, and if a ground is discovered, if found upon the circuit, the time at which that ground is removed and the character of that ground is specified.

Mr. Brophy: I would like to speak upon one topic touched upon yesterday, and that is the desirability of some method of breaking the line without cutting it with an ax; some method of disconnecting the lines in front of a building which is on fire, for the benefit of the fire department. There is no man who has studied up the sensational reports printed in regard to electric light matters so thoroughly as the average fireman. There is no man who dreads an electric wire more than he. After a wire is cut and let into the street though it be as dead as a door nail, he does not know it. If we had some method of disconnecting the lines from the dynamo by a system of switches, so fir men shall know the wires are perfectly harmless, it would be of great value to everybody interested.

Mr. Law: I can say that is practiced at the present time with us, and that every central station should send a competent man to every fire with the fire department. That has been done in Philadelphia now for nearly nine years. In some cases it has become necessary to shut down a complete circuit, where there was any danger of walls falling and breaking down the wires. I have provided in our fire wagon a cut-out which will hook over the wire, with steel pointed screws with a large wooden knob at the top, that a man can handle it with perfect safety on any wire. Using that you do not have to cut away the insulation, but the point of the screw will penetrate through and make contact with the wire. Then by the use of properly insulated cutters a man can cut loose any wire that is liable to give trouble. We have done it in quite a number of cases in Philadelphia. We cut the wires so there is no possible danger to the firemen. The firemen understand this thoroughly. They know if they come to a fire in which a wire is passing in front of a building or into a building, as a rule, the foreman of the hook and ladder company will ask me if everything is all safe. A man is generally on duty who stays by the hook and ladder companies, so they know where to pick him up at any time. The firemen have orders from the chief of the department to allow any of the electric light people, to ride upon the apparatus if it becomes necessary to get to the fire quickly.

Secretary Garratt then read the report of the committee on State and Municipal Legislation, which was as follows:

REPORT OF THE COMMITTEE ON STATE AND MUNICIPAL LEGISLATION.

For the sake of convenience and brevity, this committee recommends that its name be changed from "The National Committee on State and Municipal Legislation" to "National Committee on Legislation." The present membership of the committee is as follows: Alabama, no member; Arkansas, no member; California, George H. Roe; Colorado, C. H. Smith; Connecticut, John C. English; Delaware, no member; District of Columbia, Allen R Foote (chairman); Florida, no member; Georgia, H E. Palmer; Illinois, C. H. Wilmerding; Indiana, John Caven; Iowa, no member; Kansas, L. A. Beebe; Kentucky, no member; Louisiana, no member; Maine, Wm. R. Wood; Maryland, J. F. Morrison; Massachusetts, F. A. Gilbert; Michigan, J. E. Lockwood; Minnesota, no member; Mississippi, no member; Missouri, Joseph Cerby; Montana, no member; Nebraska, no member; Nevada, no member; New Hampshire, Alonzo Elliott, New Jersey, Henry W. Pope; New York, D. A. Maher; North Carolina, D A. Tompkins; North Dakota, Vincent S. Stone; Ohio, Chas. R. Faben, Jr.; Oregon, P. F. Morey; Pennsylvania, A. J. De Camp; Rhode Island, Marsden J. Perry; South Carolina, George B Edwards; South Dakota, no member;

Tennessee, no member; Texas, no member. Vermont, M. J. Francisco; Virginia, no member; West Virginia; John B. Gardner; Wisconsin, S. S. Badger; Washington, no member.

A persistent effort is being made to complete the membership, so that every state shall be represented. It is hoped that a leading central station man in each of the states not represented will soon be found who will qualify as a member of the association, if not already a member, and accept an appointment as the representative of his state on this committee. The assistance of every member of the association, and of all others interested in its welfare is solicited, to secure this consummation.

Electric Executions.—The resolution adopted at the tenth semi-annual convention, directing this committee to use its efforts to secure the repeal of the electric execution law in the state of New York, has not been acted upon. The committee thought it best to make no move in that direction while the question of the constitutionality of the law was undetermined. While re-affirming our belief that the law should be repealed, we are of the opinion that if it is to be enforced, it should be done in the most effective and humane manner. That the law may be so enforced, we believe it necessary that it be so amended as to require a special apparatus to be devised for the purpose, that shall generate a current of not less than 10,000 volts. In this behalf this committee recommends the association to instruct it to co-operate with the New York State association in securing such amendment of the law.

State Associations.—Since the tenth semi-annual convention this committee has engaged in the work of promoting the organization of state associations. The reason for this action is based on the fact that all legislation affecting the interests of central station companies, is either state or municipal. A state association is necessary in order to provide a medium through which the central station companies doing business in a state can act to accomplish a purpose in which they have a common interest. As there is no uniformity in legislation as between states state associations are necessary to enable the national association to carry out the "plan of work" adopted for this committee in the most effective manner. Through the grouping of central station companies into state associations, and of state associations into the national association, the full strength of the prestige and influence of the entire industry of the country can be brought to the support of any state association or of any central station company needing assistance.

In pursuance of this policy state associations have been organized in the following states:

Massachusetts, Maryland, including the District of Columbia, Connecticut, Rhode Island, New Hampshire, Maine, Michigan, Illinois, New York, New Jersey.

This work will be continued until all the states are organized. Membership in these associations is confined to central station companies doing business within the state. Any such company may become a member and be represented in the meetings of the state association by any one or all of its officers or employes, one of their number being designated to cast the vote of the company at the meeting.

While subjects of legislation have been the exciting cause for these organizations, it is expected that in the course of time the development of the work that may be accomplished through them, will render the legislative feature of the least importance or benefit. The improvements in electrical business methods that can be initiated or perfected through the bringing together of those having a common interest in such subjects cannot well be overestimated.

In view of the number of state associations now organized, and the prospect of the organization of a number of additional states in the near future, this committee recommends the association to instruct it to report for the action of its next convention, such changes in the constitution as will, in its opinion, best provide for the membership and representation of state associations in the national association.

Dangers to Investments in Central Station Companies.—Closely allied with the subject of legislation is the subject of the business methods by which manufacturing companies seek to make sales of their apparatus. As this committee was created for the purpose of instituting measures for the protection of the capital invested in electrical central stations, it considers the subject of the competition of manufacturing companies with central station companies for public lighting contracts, to be a most proper subject for the consideration of the association.

Within the last six months every dollar invested in electric central stations has felt the depreciating influence of an excited and misinformed public opinion. From such a cause these investments must continue to suffer until the means is found of furnishing the public with information that it can accept as being reliable, impartial and authoritative. While the damage done in this direction is great, it is not vital. The evil can be corrected.

Of a different character is the damage done to central station investments by those manufacturers who have, either openly or under cover of other names, sought to create a market for their apparatus by underbidding an established local company in its proposal for a public light contract. A low bid for public lighting is invariably used as a means of obtaining a franchise and the right to do business in a city or town in opposition to an existing company. Manufacturers have acquired their power to do this through the wealth and prestige they have gained by supplying existing companies with their apparatus. No demand can be more just than this: "The value of investments in electrical apparatus and construction that have been made on the basis of manufacturers' representations of earning capacity must not be depreciated by the cutting of prices, by or through the assistance of manufacturers."

This evil is vital. In destroying the profits of the business, the reason for its existence is destroyed. It is folly to discuss the mechanical or electrical efficiency of a plant, if its financial efficiency is to be destroyed by cutting the price to be received from the service it is to render, to a point which destroys all possibility of securing a fair profit for the use and risk of the capital invested in it.

For the correction of this evil the association must rely upon the work to be done by the co-operation of all central station companies to secure reasonable legislation and just conciliation.

DISCUSSION.

It was voted to take up the report by sections. On the matter of electrical executions the discussion was as follows:

Captain Brophy: The methods used to throw discredit on the electrical execution business by parties interested in securing the adoption of certain devices for that purpose are well known and I need not recite them; but I think we had better go slowly and not leave the association open to attack. As this resolution reads, it means nothing. "A current of 10,000 volts," is meaningless and the statement could be used greatly to our disadvantage by interested parties.

Secretary Garratt: I was about to speak on that point. Electricity may kill people in two ways, by nervous shock or by cooking. If this is to be adopted, I would suggest two things: First, that in speaking of a current of 10,000 volts, these words be added: 'If the machine be devised to deliver an alternating current, the pressure of that current shall be considered equal to the heating effect in a thin wire or carbon filament under a pressure of equal potential.' That prevents this being thrown out on technicality. I would also add that this machine deliver through 2,000 ohms of resistance, not over two amperes nor less than one. That will kill a man in accordance with our ideas of humanity. A 10,000-volt machine might be devised which would be equal to the tortures of the inquisition multiplied by a great many powers.

Mr. Lockwood: I move that the recommendation read that special constant potential apparatus be devised to furnish a current of not less than 10,000 volts potential and capable of delivering not less than 20 amperes.

Mr. Faban: The committee did not feel that it was part of its province to specify a bill for passage by the New York legislature. The suggestion was simply made that the voltage be placed high enough to represent a blow and not a burn.

Mr. Perry: It seems to me that it would be better to let the state take care of that matter. The fact is that the law has been adopted by the state and stands, and for political and other considerations it will stand, and it is impossible to procure enough votes to repeal it, and if you did so, you would be obliged to pass it over again. We want, if they are going to use electricity, to make a machine strong enough to kill and not have odium attached to an ordinary machine. I do not think we ought to say anything about alternating or direct currents.

Secretary Garratt: I withdraw my whole recommendation.

Mr. Lockwood: I move to amend by adding the words, "and capable of delivering a quantity of current unquestionably sufficient to kill."

Captain Brophy: With one amphere of current and 10,000 volts it is a good deal like killing a mosquito with a ten-ton hammer, to attempt to execute a criminal. If you take any notice of this at all, it seems to me you are putting yourselves in the position of killing a fly with a club, by recommending the adoption of special devices for killing criminals.

Dr. A. F. Mason: I like what Captain Brophy has said, but I hope that if they will use electricity for this purpose they will do it by machines specially devised for the purpose of killing and not for light.

Mr. Perry: This committee had in mind the very thought which Dr. Mason has expressed. I am here as the exponent and champion of no system. The fact that the state of New York had adopted certain machines to do this work, would be a serious disadvantage to that particular make of machine. Make the law state that it shall be 10,000 volts, and then that cannot be trifled with, for no executioner acting under the law would dare to announce that he had fulfilled its mandate in any other way except as provided by the statute. That is what we had in mind. If we leave this open they will construct a machine of such voltage as they choose, and they can come out and strike the very blow from their special machine that they originally meant to strike by securing an ordinary standard commercial machine. With that change we are in a position to relieve any electric lighting company from the odium of furnishing an ordinary instrument of execution for criminals. I hope the section will stand as it has been presented with the simple amendment, if Mr. Lockwood desires to add it, of a quantity of current that will insure the desired result beyond a question.

Mr. De Camp: I think Mr. Perry expresses very clearly the sentiments of the whole committee and the idea that it had in making that report. We cannot alter the law. The committee which has had the matter in charge, find that there is a strong tendency to keep it on the statute book; electric execution must be the law of the state of New York. A bungle of an electric execution, or one or two of them, means the repeal of that law just as sure as we are here to-day. The sentiment worked up on that subject is purely on the ground of the humane method of the execution of criminals. Just as soon as the public sees that it is not humane, it is very easy for us, if it is necessary to take any action at all, to have that law repealed. Therefore, I think, if the resolution stands as it is, it will accomplish the object we have in view just as effectually as we can do it in any way.

Dr. Mason: Can't we work just as strongly without any action on the part of the association? Do the committee need our action?

President Weeks: I will say that that matter was presented in strong language to the authorities in the state of New York on former occasions, and my idea in raising this point was, that the action of it is association which is a semi-scientific body be not unscientific; it seems to me that this section can, by a very simple amendment, be made to meet all the requirements. The committee thought it should receive some support.

Mr. Perry: I think there is something here to guard, and that is the interests of electric lighting throughout this land. No one can deny that it is important, if it is possible, to draw a broad line between the killing machine and the commercial lighting machine. The committee arrived at the conclusion after a very careful examination, that we cannot stop the act on of the law, but the next best thing is to so far relieve commercial apparatus from the odium of being used for that purpose.

President Weeks: I wish to say that a few months ago I visited Mayor Maher of Albany, who was the chairman of the committee appointed at our last convention to present this matter to the governor of New York, with a view of finding out what had been accomplished and what might be done. He told me that he had seen Governor Hill and the latter had expressed himself very positively against doing anything in the line of the petition which we had submitted to him. I then suggested to Mr. Maher that in order to relieve the commercial apparatus and avoid any strife between commercial interests, a recommendation be made to the authorities that special apparatus be devised upon the specifications of some eminent scientist who had no connection whatever with any commercial interest. Mr. Maher said that he thought something could be accomplished in that line and that he had no doubt that if that line was followed up properly the desired result could be reached. While I have heard nothing from him on this subject I understand from the chairman of this committee that this matter has been followed up and that they have hopes of accomplishing by this means the desired results. I only want to have the action of the convention go out as technically correct.

The motion of Dr. Mason to adopt the section as read was then put and unanimously carried.

The reading of the report was then continued and upon its conclusion Mr. De Camp moved the adoption of the recommendation to appoint a committee on revision of the constitution and on the formulation of by-laws. The motion was adopted.

The whole report of the committee was then adopted.

Report of the Executive Committee.

Gerald W. Hart then read the report of the executive committee as follows:

The executive committee has confined its work largely to the present convention; other matters connected with the association having been delegated largely to special committees. The following committees have made reports at this convention, and the reports have been accepted and spread upon the minutes: Committee on underground conduits and conductors, E. T. Lynch, Jr., chairman; committee on harmonizing electric light and insurance interests, P. H. Alexander, chairman; committee to confer with Mayor Grant in regard to the International Exposition of 1892, Dr. Otto A. Moses, chairman; committee on electrical data, A. R. Foote, chairman; committee to memorialize congress on the abolition of custom duty on copper, C. A. Brown, chairman; committee on standardization of potential on electric street railways, E. T. Lynch, Jr., chairman; the national committee on state and municipal legislation, A. R. Foote, chairman.

The work upon which these committees have been engaged is of great importance to the association, and the reports show that the subjects entrusted to them have been carefully considered, and a great amount of work has been accomplished. The secretary informs us that the number of communications from these committees which have gone out to the electrical public exceeds 12,000.

The following committees have not reported: Committee on patent legislation, Arthur Steuart, chairman; committee on electrical execution, E. W. Maher, chairman. Owing to the fact that the members of the executive committee are so widely separated, but one meeting has been held prior to the present session, since the Niagara Falls convention, although the members have been in constant communication.

At the above named meeting held at New York on October 25, the date of the present convention was decided upon, and a general programme was outlined; also an important resolution upon the compulsory use of underground system for high potential circuits was passed.

The finance committee, a sub-committee of the executive committee, has audited and approved the accounts of the treasurer. A committee on credentials has been appointed for the purpose of examining the credentials of the active members.

The finances of the association have never been in better condition than at present, or the future more promising. The experiment of the past year of having the headquarters of the association at New York, has proved to be an entire success.

Since the last convention there has been a net gain of 61 members; the total membership being now over three hundred. At a recent meeting the following names were unanimously recommended for honorary membership in the association, agreeable to the constitutional provisions therefor: See article 3, section 4,

Sir William Thomson, Prof. Henry A. Rowland, Chas. F. Bush, Thos. A. Edison, Prof. Elihu Thomson, and Frank J. Sprague.

The report was then voted upon by a standing vote and unanimously adopted.

The association on motion then adjourned until 3 o'clock p. m.

Friday Afternoon's Proceedings.

The announcement that an exhibition of the phonograph would be given and that a phonograph speech by Mr. Edison was on the programme attracted a large audience to the Coates Opera house. Almost every seat on the main floor was occupied. The convention was called to order at three o'clock. President Weeks called upon Marsden J. Perry, the new president, and introduced him to the convention. He was received with applause.

Mr. Perry: I am deeply sensible of the honor which you have conferred upon me, by electing me as your president. I know at our convention in Chicago, there seemed to be a critical moment, a year ago, when a strong man, and a true one, was needed for the position of president of this association. Then it came to me on the instant that we had with us at that time the very man; a man of scholarly tastes, exceptional business ability, sound scientific acquirements, and the necessary firmness for an executive officer. His name was Edwin R. Weeks of Kansas City, Mo. Mr. Weeks accepted the honor, and I assure you that when he did so it took a man of considerable courage, and out of some confusion has arisen the present occasion, our annual convention, by all means the most successful, the most instructive one that we have ever held. The history of the National Electric Light association is but five years old in point of time, but the science and its application commercially are 100 years in point of advance, as compared with the previous hundred years. We have assembled here to discuss the topics of interest to us. We have now about concluded our labor, and shall return to our toil. I wish to thank you in behalf of the National Electric Light association for the wealth of hospitalities which we have enjoyed here in your city and at your hands.

You, Mr. President, have nearly finished your official course, and are about to lay down the duties and responsibilities—responsibilities, sir, in the acceptance of this office of which I am not unmindful. But in separating yourself from the office, you leave this association under a debt of gratitude and obligation that it will take long to repay. You take with you into your unofficial life, a bond of sympathy, a warmth and depth of feeling that will not soon be broken, marred or forgotten.

Gentlemen of the convention, the grand results which have been achieved from so small a beginning, have not been accomplished by a single hand. It has only been by united effort, and I shall rely on you during the coming year for a strong united effort as well as on your indulgence with me, that we may repeat again, if possible, the glorious record of the past year.

President Weeks: We are fortunate in having with us on this occasion one who has been for years intimately connected with Mr. Edison, one whose name has stood for the Edison interest throughout America; one whom I have, on urgent solicitation, succeeded in inducing to address you. I take great pleasure in introducing to you, Edward H. Johnson of New York City.

Mr. Johnson: President Weeks has sufficiently apologized for my appearance before you, to speak upon a matter, that comes in the nature of a surprise to me; and he has also explained why I am called upon to speak—concerning Mr. Edison's phonograph. Having been associated with Mr Edison, in the laboratory and out of it, almost constantly now for the past twenty years, I am necessarily more or less familiar with everything that he has done. The phonograph, however, is an invention with which I am particularly familiar. Therefore it would seem appropriate that I should comply with the request of your chairman and say a few words to you on that subject. At first he only called upon me to explain the operation of the instrument, the principle upon which it acts, and to that I assented Then he broadened out his request until finally he wishes me to go at some length into the history of the instrument and the whole subject. To do Mr. Edison justice, and to do myself justice, I could not well do that. I have agreed, therefore, simply to relate the circumstances under which the phonograph had its origin, to explain the instrument to you and then call upon the gentlemen who have the device in charge to operate it for your benefit.

When Professor Bell brought out the magneto telephone with which you are not only familiar, but which your children now know, Mr. Edison conceived the idea of amplifying the voice of the telephone, so to speak, by producing a transmitting apparatus which would generate a much stronger current than Mr. Bell's instrument did; and thus by operating upon Mr. Bell's instrument as a receiver, produce a much more audible and distinct vocalization, and render the instrument of much wider commercial value. These experiments ultimately led to the carbon telephone transmitter now universally used throughout the world and which you all recognize as the instrument to which you address yourselves when you are speaking in the telephone; and it was in the course of his experiments with that instrument that he conceived the idea of the phonograph. It did not dawn upon his mind, or for that matter upon the mind of any of us associated with him at the time, just what he had done, that is, produced a talking machine. He remarked to me one evening when he was pressing his finger lightly against the diaphragm of a telephonic instrument, and feeling those vibrations, "Johnson, if I was to put a needle in the center of that diaphragm and make a point there, an indenting point like the point on the old time Morse telegraph register," with which you are no doubt all familiar, "then draw a slip of paper or other easily impressed substance underneath that needle, the vibrations of that diaphragm would be accurately recorded on that paper." Being an old telegraph operator myself, I immediately saw the force of that apparently not very sa.e remark, and I said, "Certainly it will, but what of that?" Well, he said, "If we take that paper and start fresh with it, and draw it under the point of that needle or diaphragm put a slight tention on the needle and pull the needle, it will follow the ins and outs of these indentations that naturally would be in the diaphragm, precisely as it did move when it made the original indentations." I said, "That is true; but what of that?" "Well, only this, that would be a telephone repeater. Of course if I speak in the telephone and that produces a vibration on the receiving telephone's diaphragm, that receiving instrument is made to record these indentatious on that piece of paper, and that paper is afterward drawn under that needle, that diaphragm re-vibrated, without the action of the human voice, I have only to make that second diaphragm another transmitter and I will carry my message on again to another station Thus instead of telephoning within the limit of the capacity of a single instrument, I will telephone to these limits, and then automatically repeat the speech over another circuit to the limits of the second circuit. In other words, you will make a telephone repeater that will be the exact counterpart of the telegraphic repeater so well known in general use" I said, "It looks feasible; it looks practicable." That was the end of it for the time being. Neither one of us or Mr. Batcheller or the other laboratory associates of Mr. Edison thought any more about it for a long time. I was in somewhat straightened circumstances at the time, as we all were, owing to the fact that we had spent some six years in developing a system of electric automatic telegraphy which we sold to our friend Mr. Gould who was several years paying for it and has not yet settled up entirely. The situation w s that we had to look around and see what we could do to earn our bread and butter Mr. Edison has since fou d a way of earning his. I had to strike out in some new direction; and it occurred to me it would be a very good idea to go around to the leading water places, this being summer time, and exhibit Edison's telephone and apparatus, particularly the musical telephone; describe it to the public, who seemed to be very much interested in these acoustic experiments of Mr. Edison and Mr. Bell at that time, and make a little money that way. I did it by having my singers stationed in the Western Union Telegraph building in New York, having my receiving apparatus in a house like this at Sara'oga, Buffalo or Rochester, four or five hundred miles distant from New York, and reproducing the voices of these singers to my audiences at these distant points. It was very successful. A great interest was being aroused in the subject just at that time. In the course of one of my lectures, or improvised talks, it occurred to me it would be a good idea to tell my audience at Buffalo about Edison's telephone repeater, which I did. My audience seemed to have a much clearer appreciati n of the value of the invention than we had ourselves. They gave me such a cheer as I have seldom heard. I did not comprehend the importance of the device at the time; but the next morning the Buffalo papers announced in glaring headlines, "A Great Discovery: A Talking Machine by Professor Edison. Mr. Edison's Wonderful Instrument will Produce Articulate Speech with all the Perfection of the Human Voice." I realized for the first time that Edison had, as a matter of fact, invented a talking machine. The immediate importance to me was that this created a sensation, and I had very large audiences in all my entertainments thereafter. Realizing that and having had sufficient experience by this time to profit by such things, I made a special point of this feature in my next entertainment, which was at Rochester, and I had a crowded house; one that did my heart good—and my pocket too. There was a most magnificent enthusiasm. That satisfied me that I had better go home and assist in preparing this instrument. I knew from my own experience in the matter that it was a comparatively simple thing to do, so I canceled thirteen engagements ahead and went back home with these newspaper clippings. I went straight down to the laboratory, which was then at Newark, and I said, "Mr. Edison, look here. See the trouble you have got me into." He read these things over, and said: "That is so; they are right. That is what it is—a talking machine." I says: "Can you make it?" He says: "Of course. Have you got any money?" I says: "Yes, I have a little." And I had—a little. He says: "Go to New York and get me three feet of stub steel an inch and a half in diameter, and get me a piece of brass pipe four inches in diameter and six or eight inches long, and bring it down here, and we will make it." I took the next train to New York and got the material, took it back and went to work. Within twenty-four hours we had a little revolving cylinder, turned with a crank, and a simple diaphragm needle, which I will explain presently, wrapped a sheet of tin-foil around the cylinder, and gave it the original phonographic sentence, "Mary had a Little Lamb." Then we set it back, to see what the instrument was going to do about it. It came out to our entire satisfaction. Not as clear as it does today, but it was "Mary had a Little Lamb," sure enough. That was the original phonograph, and the starting point of an invention, which, notwithstanding all that Mr. Edison has done since, notwithstanding my high appreciation of what he has accomplished, notwithstanding the commercial value, the vastly greater relative commercial value, of his subsequent inventions, is to my mind the greatest thing he ever did, and which, as a matter of fact, is the invention which has carried Mr. Edison's fame and name outside of the comparatively limited technical circle in which he was then known, throughout the civilized world, and makes today the simple announcement that somebody, it makes no difference who he may be, known or unknown, is going to make a few remarks about Edison, quite sufficient to crowd the largest auditorium with the most intelligent members of any community, in this country or abroad. And I speak from experience when I make that statement.

Now, a few words in explanation of this instrument, and then you shall hear it. In the first place, there is a mistaken idea as to the character of this instrument. It is popularly supposed to be an electrical instrument, because it is the invention of the greatest of all electrical inventors. It is not an electrical instrument at all. It is a mere bit of mechanism. It is a mechanical arrangement, pure and simple. It is necessary to have a revolution of the cylinder, and to get that mechanical motion you must have some motive power As I explained the original machine was turned by hand. Others have been turned by water motors, gas motors This instrument on the platform is operated by an electric motor. That is a matter which has no significance in relation to the machine; it is merely the motive power to turn the instrument, and is no part of it. The instrument is simply mechanical. Its principle is this: When I speak I throw the air into vibration of a given form. That strikes upon the ear and produces on the auditory nerves certain sounds, or rather they convey to the brain certain sounds, that is, what we term sounds. Those sounds are infinite in variety, but they have an intelligent meaning to the brain, that meaning being simply a matter of education. It follows, therefore, that if I can produce those vibrations on the air by other means than my own voice, but precisely and identically those vibrations. I will produce upon the ear and consequently upon the brain, precisely the same sensations and they cannot mean anything else in the one instance than in the other. Therefore, this invention is nothing more or less than an instrument which will accurately receive and record those vibrations, and retain their character, form and number with absolute precision, and then mechanically do the work by operating something which will contribute again to the air, all those peculiar waves of the vocal chords of precisely the character and form of the vibrations that it originally received. If it can be done, you will, of course, at once perceive that the instrument, although a bit of mechanism, if it has the capacity to reproduce these vibrations, it necessarily has the capacity to produce upon the brain precisely the same sound that the vocal chords produced in the first instance. Therefore, what we want is an instrument that will do that. Now let us see how we make an instrument of that kind. You take anything, no matter what, a piece of paper like this (indicating) and utter a sound, the musical note "do" for instance, and in touching it with your finger on the opposite side, you feel the vibration. Very well, we will call that the diaphragm, a paper diaphragm. We will put that in a suitable frame, and hold it in such a position as we want. Then we will attach to the center of that diaphragm, because the center is the point of the greatest amplitude and the greatest vibration necessarily, a needle, not a sharp pointed needle, but a needle whose point is comparatively sharp, one that will not scratch, but will simply produce the indentations upon that yielding substance. Take and arrange that in such a way that this diaphragm that has this needle point against the surface of the revolving cylinder. Now, we will put around that revolving cylinder that substance—paper is a little too hard for the needle to indent, of course; but tin foil which is much better, and it was therefore used for a long while, so we will say tin foil for the time being—we will put around that cylinder a sheet of tin foil, and we will adjust this instrument, so this needle will press slightly against that tin foil. Now, we will revolve the cylinder with a screw attachment at the end, so that the cylinder shall go past, transversely, in front of this needle, very gradually, so as to present a constantly new surface of tin foil to the needle. Now, you speak against that diaphragm and cause a vibration of this needle, while that tin foil is passing in front of it, and you will necessarily produce on that tin foil indentations of precisely the same number, and of a depth corresponding to the amplitude of vibration of the diaphragm, precisely the same as the diaphragm yields, and that will yield precisely the same vibrations as the air yields that has been put in motion by the voice. Consequently you have an absolute record on the tin foil of the vibrations of the air affected by the vocal chord, not only in number, but of the same character in all other particulars. Now, if you will reverse the action of this cylinder, turn it backward, if you please, then drag the needle back again, onto these indentations just where they began, and do nothing but simply rotate that cylinder, so as to cause the needle to traverse the ground over again, thus going in and out of all the little indentations, you get precisely the same effect upon the diaphragm as you had originally, because it now being moved by the rough path, so to speak, which it previously created, it must necessarily follow the same ups and downs. So that you get the diaphragm in motion again as it was before, with the net result that the diaphragm contributes to the air precisely the same movement that the air had sent out from the diaphragm. Consequently you get perfectly articulated speech. That is all there is to the instrument. This instrument lay dormant for about twelve years. Mr. Edison went from his telephonic experiments immediately into his electric light experiments, and consequently gave no attention to the phonograph, always saying to those of us who would urge him to take the matter up: "When I get through with this I will take that up. That shall be the next

thing." But the electric light came along, and before he got through the carbon transmitter he took that up, and the phonograph was ignored. Then he promised to take it up when the electric light matter was settled. Before he had satisfied himself with his work in that direction others took up the phonograph and worked on it to considerable purpose, namely, Messrs. Taintor and Bell, Professor Bell of telephone fame. He and his associates took the matter up and endeavored to make a phonograph which was then merely a scientific novelty. In other words, to do for Edison's phonograph what Edison had done for Bell's telephone, make it a commercial as well as a scientific success. They succeeded in developing what has proven to be the correct principle, namely: that instead of making indentations in this plastic substance, wax, which is now the thing used, they made a little cutting knife, and actually cut the material out with each vibration, thus effecting two things, a more decided record than was made by the indentation method.

The result of that was an instrument which while it did not speak and was not intended to speak in the original voice, as the old tin foil phonograph did, yet it spoke with such distinctness that if you placed the tubes to your ear, while the voice was low, it was wonderfully clear and the utterance was easily comprehended. They brought out on the basis of that improvement what is now universally known as the graphophone which is simply the phonograph turned the other way around. They did not claim to have anticipated Mr. Edison in this great discovery. They simply claimed to have perfected Mr. Edison's instrument and thus brought it into the realm of commercial utility; but they did not make the progress that they expected, and Mr. Edison then took the subject up again, and the result of his efforts in that direction was the perfected phonograph. Consequently we now have the graphophone and the phonograph.

A very shrewd gentleman in New York, recognizing the great possibilities of this thing, went to work to acquire the ownership of both. Consequently the North American Phonograph company to day is the owner of all the rights of the graphophone and the phonograph, and there now being but one common instrument, the aim in this instrument is to give you all that is known of the last and best development of this wonderful apparatus which is to record what we say, keep it for any length of time, and then reproduce it for any purpose we may wish with as perfect a retention of the character and quality of the original voice as the telephone to-day in its best form. I want to say that this instrument, although it is fitted up here with a rather elaborate contrivance so that you may hear it, is designed expressly not to do that which we are going to call upon it now to do, namely, to talk loud. It is designed to address itself to the individual ear. That is because the instrument is intended for commercial use, and we do not want the message or letter which I have dictated in my study at home and sent to the office to have the typewriter put it in writing, to be heard by everybody in the room. Consequently the instrument is designed to speak in a low, clear tone to the ear. We can make them speak as loud as we please, but at some loss of clearness of articulation. Inasmuch as it is impossible for everybody to assemble around the instrument closely, we will endeavor to make the instrument speak loud enough for you all to hear. In this connection I will say that Mr. Levy played in that instrument many years ago and frequently since, and invariably took pains to inform the audience that the phonograph was his only competitor on the cornet.

Phonograph Exhibition.

The phonograph was then brought into action, and after reproducing several cornet solos by Levy, it presented the following message from Mr. Edison:

"*Edwin R. Weeks, Esq.*,

"Kansas City, Mo.

"My Dear Mr. Weeks,—

"When I had the pleasure of meeting you at my laboratory in December last, you suggested that I should send to the Kansas City convention, which commences next week, a phonograph discussion upon the subject of my five wire system of distribution, which you were good enough to assure me would prove of interest to the delegates, and ever since that time I have been trying to find an opportunity to prepare the data.

"My failure to do so has been through no fault of yours, as your letters have constantly kept the matter before me, nor has it been through want of inclination on my part that I am obliged to substitute this explanation.

"Certain urgent matters of business which I was unable to anticipate have occupied my attention to such an extent that I have even had to neglect the important work of my experiments.

"While I could not have contributed to the success of the convention, which is already assured through its location in you enterprising city, I regret that I am unable to send something which would at least be more interesting than this apology.

"Yours very truly,

"Thos. A. Edison."

After Mr. Edison's message had been uproariously acknowledged by the audience, the phonograph was persuaded to furnish a xylophone solo with a piano accompaniment, which received an enthusiastic reception.

Electric Light Competition.

The business of the convention was then taken up, and the following was offered by Mr. De Camp:

Whereas, more than $100,000,000 have been invested in central electric light companies in America, and,

Whereas, the stocks and bonds of these companies have been and are being depreciated and jeopardized by a reckless and disastrous competition encouraged and fostered to a large extent by rival parent companies; and, Whereas, this course of conduct threatens the destruction alike of central station companies and of parent companies, the profitable continuance of whose business depends upon the healthy life of the central station companies, therefore, *Resolved*, that the National Electric Light association appoint a committee of seven whose duties shall be to devise and execute plans for the prevention of the evils referred to, *Resolved*, that the president appoint this committee, and that any vacancies occurring be filled by the incoming president.

The resolutions were supported by Dr. Mason of Boston, Mr Armstrong of Camden, N. J., Mr. Lockwood of Detroit and Mr. Francisco of Rutland, Vt., and were unanimously adopted.

The chair announced the appointment of the following committees:

On Underground Conduits and Conductors—J. E. Lockwood of Detroit; C. H. Wilmerding of Chicago; Schuyler S. Wheeler of New York, T. C. Smith of Philadelphia, and David E. Evans of Baltimore.

On Revising Constitution and By-laws—Dr. J. W. Mason of Boston; A. J. De Camp of Philadelphia; E. A. Armstrong of Camden, N. J.; M. J. Francisco of Rutland, Vt., and E. R. Weeks, of Kansas City, Mo.

On Relations Between Parent and Sub-companies—Marsden J. Perry of Providence, R. I., chairman; J. A. Morrison of Baltimore, Md.; J. E. Lockwood of Detroit; Gilbert of Boston; E. A. Armstrong of New Jersey and E. R. Weeks of Kansas City, Mo.

George Cutter of Chicago, presented a resolution providing for the appointment of a committee of five to choose three representative electrical men to act on a committee for the purpose of devising and adopting national insurance rules, and considering any other matters affecting the joint interests of insurance and electrical companies, further, also providing, that the committee of five be requested and authorized to negotiate with the general insurance organizations throughout the country with a view to securing the appointment by them of representatives on a national electric insurance committee, and that the committee of five report the result of its deliberations and actions at the next meeting of this association.

Dr. Mason of Boston: I wish to introduce the customary resolution, which if ever offered would be most fitting this occasion. I move that the National Electric Light association express to the people of Kansas City generally, to the railroads, the surface roads, the local reception committee, the transportation committee and all others who have extended us special courtesies, our heartfelt thanks as an evidence of our appreciation of all their generous treatment. I might add very much more, but no words that I could use would more clearly express my deep sense of appreciation of their kindness.

The resolution of thanks was adopted unanimously by a rising vote.

Secretary Garratt announced the reception of a letter from the chairman of trustees of Guthrie, Oklahoma, inviting the association to visit that city.

Dr. Mason suggested that the association instruct Secretary Garrett, if possible, to visit Guthrie, and express to the citizens of that city the good will of the association, taking with him any members who wished to accompany him. Dr. Mason's motion was carried.

Closing the convention, Chairman Weeks said: "As we have finished our business, I now declare this convention adjourned."

Convention Notes.

The headquarters of the association at the convention at Cape May next August will be at the Stockton.

The weather in Kansas City was all that could be desired. There was a dash of rain one evening, but it did not continue long enough to keep the delegates within doors.

Mrs. E. R. Weeks, wife of President Weeks, of 1409 Cherry street, and Mrs. F. B. Tiffany, of 1818 Tracy avenue, were at home on Thursday morning and received quite a number of ladies who were attending the convention.

A special train on the "L" road was tendered the delegates and a pleasant ride was had by many of them to Chelsea Park and return Tuesday afternoon. The Board of Trade committee on reception accompanied them on their trip.

President and Mrs. E. R. Weeks gave an informal reception in honor of the delegates at their residence on Cherry street Thursday evening. A large number of delegates called during the evening and congratulated Mr. Weeks on the success of the eleventh convention.

The residents of Kansas City ought to be thoroughly familiar with Ohm's law. In all the newspapers, on all the hotel menus, in shop windows, on hangers over the street, could be be seen the formula $C = \frac{E}{R}$.

On the afternoon of Wednesday, February 12th, a large party of delegates visited Excelsior Springs, a resort about 30 miles from Kansas City, at the invitation of the Chicago, Milwaukee & St Paul Railway company and the Excelsior Springs Hotel company. The railway company put at the service of the delegates a special train. On reaching Excelsior Springs the party found carriages in waiting and the visitors were driven to the hotel, about a mile distant. After a brief reception, dinner was served. Over 300 persons sat down at the tables. Music was furnished by a string orchestra.

All the delegates at the convention were provided with badges which were of a unique design. They were silver and in the form of an ivy leaf. On the face of the leaf were the letters "N. E. L. A," the formula $C = \frac{E}{R}$, and the words "Kansas City 1890." The badges were not only ornamental, they were extremely useful, inasmuch as they enabled the wearers to ride without paying fare on the Kansas City street car lines

The chief ornament in the Coates Opera House when the convention was called to order was a design in incandescent lamps arranged over the stage. The globes, which were red, white and blue, represented the formula, $C = \frac{E}{R}$. The lamps were 115 in number. The globes were colored by Mrs. G. W. Hart. M. E. Bates of the Western Electric Construction company did the construction work, and the Kansas City Edison company furnished the lamps and the current.

Meeting of Carbon Manufacturers.

During the sessions of the convention in Kansas City there was held a very important meeting of the carbon manufacturers. There were present G. W. Parker, D. R. Russell, C. W. Hazeltine of the Parker-Russell Mining & Manufacturing company of St. Louis; J. B. Crouse of Standard Carbon company of Cleveland, Ohio; W. C Hayes, B. F. Miles, W. H. Lawrence of the National Carbon company, Cleveland, Ohio; Geo. F. Porter and A. E. Carrier of Faraday Carbon company of Pittsburg; H. B. Lucas of the Washington Carbon company, Pittsburg; C. D. Richmond of the Thomson-Houston Carbon company. The meeting was held for the purpose of taking certain action toward obtaining a lower classification in the freight schedule on carbons. When electric light carbons were first placed on the market the idea was prevalent that they would be a very difficult class of freight to handle and a large percentage of loss through breakage would have to be borne by the railroad companies. Consequently they were rated as first-class freight and up to date no change has been made in this classification. It was stated that the railroad companies had never yet been called upon to pay a loss from breakage or any other cause upon carbons. This of course makes the classification still more unjust. A committee was appointed to consult with the railroad officials and endeavor to have carbons classed in the lowest grade of freight, where they properly belong. The committee consisted of G. F. Porter, A. B. Richmond and G. W. Parker, who will take the matter in hand and report to the various companies at an early day.

Reception at the Kansas City Commercial Club.

The Commercial Club of Kansas City tendered a reception to the delegates of the National Electric Light association on Tuesday evening, February 11. The reception took place at the club rooms in the Exchange building. A large representation of the most prominent business men of Kansas City was present. A large number of electric light delegates were present and were given a cordial reception. After an informal reception of an hour or more, President F. A. Faxon called the assemblage to order. He said: "We are always glad to meet those who are carrying on the world's great work. When we begin to realize what has been done in electrical science since Franklin's time, we are almost bewildered. Among the treasures of science none are more precious than those which have been obtained by those who have learned to control the lightning. It is a pleasure, therefore, for us to have such a distinguished body of scientists meet in our city. To America belongs the honor of discovering most of these treasures, and it always seemed fitting to me that the statue of Liberty at the entrance of New York harbor should bear a torch of electric light. We have a city here which in its hustle and growth is perhaps without a parallel in the country. You must remember we are young. By the side of the buildings which tower to the sky are still to be seen the cabins of the pioneers, and the pioneers are still with us. In building up the city we want the best, and if you have the best then we want to buy it."

President Weeks made a brief address in which he acknowledged the courtesy of the Commercial club. In the course of his address he said: "To the minds of the guests the meeting of the Electric Light association brings many recollections of good-fellowship and of service in the cause of science and commerce. In the minds of the people, I am afraid, we are thought of as misers and magicians who are operating with a death-dealing agent. Such remarks, Mr. President, as you have made will lead to correct these impressions and to show that our work is essential to the best interests of the community."

F. A. Wyman of Boston made an address in which he urged the necessity of harmony among electric light men, and argued against the practice of some companies of speaking of their competitors' apparatus as dangerous. After the speeches the informal reception was resumed. The gathering was thoroughly enjoyable.

THE EXHIBITS.

The exhibits of electrical apparatus of all kinds were made in the Casino Hall, a building situated a few steps from the headquarters of the association. The exhibition was an extensive one, and it attracted the attention of a large number of residents of Kansas City. The hall, lighted by scores of incandescent and arc lamps, presented a brilliant appearance. Following are brief descriptions of the exhibits:

Fred H. Whipple of Detroit, distributed the February edition of his electrical reports both at the Casino and in the Convention hall.

J. H. Heverling of St. Louis, had on exhibition a model showing his new iron pole for electric light and electric railway purposes.

The Centropolis Car & Machine company of Kansas City, distributed a large number of note books among the delegates and visitors at the convention.

Capt. Willard L. Candee was present as usual to descant on the merits of the Okonite wire, which formed a prominent feature of the exhibits in the hall.

The Phœnix Glass company of New York, was represented by E. B. Patterson, with a small but tasteful display of glassware manufactured by them for electrical purposes.

Geo. C. Pyle, electrician of the National Electric Headlight company of Indianapolis, had a number of photographs showing the results obtained from the use of his new electric headlight.

Bernard H. Schmidt of Chicago, the western agent of the J. G. Brill Car company of Philadelphia, showed in Casino hall a very handsome truck of their new type for electric motor service.

W. H Jones of the Jones Bros. Electric company, of Cincinnati, Ohio, was an interested listener to the discussion in the convention and a close observer of the new exhibits in the Casino building.

Chas. A. Schieren & Co. of New York, were represented by C. A. Schieren, Jr., and F. W. Baugher. They showed a fine line of their special link belts, perforated belts and regular electrical belts.

Paul W. Bossart of Kansas City, had charge of the exhibit of the Rockford Electrical Manufacturing company, which consisted of two of their latest type of electric motors. Mr. Bossart is also agent for the National Electric Traction company of Detroit.

H. T. Paiste of Philadelphia, was well represented in the person of Wm. R. Hood, whose exhibits were much too attractive to be kept in his overcoat pocket and were therefore nicely displayed in the space allotted to him. The exhibit consisted of all the new Paiste specialties, switches, cut-outs, and pendants.

Col. J. H. Shay as usual had charge of the exhibit of the Chas. Munson Belting company of Chicago, which consisted of a forty-two-inch leather belt with a number of smaller sizes arranged so as to show the peculiar adaptability of these belts for electrical purposes. Mr. Shay also distributed among his friends at the Convention a number of leather canes.

The Central Electric company of Chicago, was represented by W. H. McKinlock and F. W. Cushing. They showed a number of their new spark arresters for arc lamps and a new tin shade and the central lighting arrester. Also a large stock of Okonite wire of all kinds and sizes. They distributed large numbers of the attractive calendar which they recently issued.

In the gallery was located the exhibit of the Kansas City Engineering company, the agent of the Sprague Electric Railway & Motor company. Two machines were shown, a 5-horse power and a ½-horse power motors. The latter operated a 24-inch ventilating fan. The switch for the larger machine was the Whittingham automatic, which has a deservedly high reputation.

The Ansonia Brass & Copper company of New York and Chicago, were represented in the Casino hall by their western manager, Gilbert M. Smith of Chicago. Their exhibit consisted of a full line of samples of all kinds of bare and insulated wire manufactured by them, among which was a new special brand called the "A. B. C. line wire" which they are now bringing to the front.

The Jenney Electric Motor company, which recently succeeded to the business of Chas. D. Jenney & Co. of Indianapolis, was represented by Chas. D. Jenney, who showed a one-horse power motor of their latest type driving a coffee mill, and explained with a rare exhibition of patience the merits of what he modestly claimed to be the very best of the many inventions he has given to the public.

The Hill Clutch Works of Cleveland, had in the space allotted to them one of their largest Hill friction clutches in charge of S. S. Leonard of Chicago, manager of their western department. Mr. Leonard has recently moved to Chicago from Minneapolis to take charge of this business, and his large acquaintance among electrical people will certainly bring much trade to any interest with which he may connect himself.

C. H. Cone of Chicago, took advantage of the convention season to pay a visit to his old home in Kansas City, where he formerly represented the Electrical Supply company of Chicago. Mr. Cone has recently opened an office in the Electric Club building in Chicago and has secured a number of agencies of prominent eastern manufacturers. His large number of acquaintances will wish him unbounded success in his new undertaking.

C. E. Newton, secretary of the Jewell Belting company of Hartford, Conn., had charge of the exhibit of this company, which was located to the right of the entrance in Casino hall. It consisted of a full assortment of all kinds of main and ordinary driving belts, as well as their new light double dynamo belt. The special feature of this exhibit was their dynamo belt which is made of whole hide perfectly even in thickness and is treated to their water-proof dressing which renders it very pliable and noiseless. This company carries a full line of all their various grades of belting at their branches represented by English Morse & Co. of Kansas City.; W. A. Salisbury & Co. of Chicago; Todd & Stanley company of St. Louis; A. H. Gardner company of Milwaukee, and E. C. Atkins & Co. of Indianapolis, Chattanooga and Memphis.

The Interior Conduit & Insulation company of New York, had a most interesting exhibition in the gallery of Casino hall. On a large board on the wall were located a number of the company's conduits, in which were conducted wires carrying current for several lamps. The exhibition was a practical demonstration of the completeness of the company's system and of its great ability in the location of wires in buildings. The exhibit was inspected by a great number of electric light men who found the system full of great interest.

The Evans Friction Cone company of Boston, was represented by J. R Conant, who brought with him a number of photos showing the working of their apparatus as applied to the different means of driving electric generators. It happened that several managers of stations who have this system in operation were present at the convention and were loud in their praise of it and quite a number of the superintendents of the large stations in the west were so favorably impressed with the system that they have signified their intention to adopt it shortly.

Southwestern Electrical Supply company under the management of Edward LaSalle, made a very creditable display of all their electrical sundries and the various manufactures they handle. The exhibit consisted mainly of a large display of Grimshaw wire for which they are the southwestern agents. All kinds of electrical batteries, arc lamp globes, insulators, magneto bells, pushes and gongs made up a very fine display. A one-horse power Perret motor was in this exhibit and attracted a great deal of attention owing to its recent introduction in the west.

The Standard Carbon company of Cleveland, Ohio, made an exhibit of all their different sizes and styles of carbons, arranged in very attractive style upon a large blackboard. The display included every size and style of carbon manufactured by them and represented a large and variegated assortment. This company are also manufacturers of the excelsior belt oil, sample bottles of which were arranged in their exhibit and distributed among the callers. The exhibit was in charge of J. D. Crouse of Clevelard, and W. W. Low, the Chicago agent of the company.

J. A. J. Shultz of the Shultz Belting company of St. Louis, occupied a space in Casino hall exhibiting a new leather link belt upon which he has just been allowed a patent. This belt differs from the other leather link belts on the market in that no iron is used in its construction. The thongs which hold the links together are made of leather, which it is claimed gives the belt a greater pliability and yet retains all the advantages of those connected by iron. Mr. Shultz also exhibited a section of his new leather covered pulley which was described and illustrated in a recent issue of the WESTERN ELECTRICIAN.

The National Carbon company of Cleveland, Ohio, was represented by W. H. Lawrence, B. F. Miles and W. C. Hayes. The exhibit consisted of a display of the carbons manufactured by them ranging in size from that of a knitting needle to those 2½ inches in diameter and four feet in length, the latter being used for aluminum smelting purposes. There was also a good display of their battery carbons, carbon plates and carbon brushes. The gentlemen in charge distributed large numbers of their directory of arc lighting plants and also a calendar which they publish containing the moonlight schedule.

George Cutter of Chicago, had one of the most attractive exhibits in the Casino hall. It consisted of the several lines of specialties handled by him arranged in a manner calculated to interest all. Bernstein series lamps and shades, formed a prominent feature, while Cutter's new tin lamp shade and reflector, safety plugs, switches, fuse boxes and other sundries filled the show case and the tables which occupied the space. The Simplex wire, for which Mr. Cutter is the Chicago agent, was prominently displayed. Mr. Cutter was assisted in the care of his display by D. T. Everts and Dr. Mason of the Simplex Wire company.

The Gate City Electric company of Kansas City, occupied the southeast corner of the Casino hall with a fine display of all kinds of electrical goods. This company was recently organized in Kansas City but has already established itself among the leading concerns in its line. They are agents for the Okonite wire, a number of reels of which served as the boundaries of their space, while a pile of Manson tape occupied a prominent position on the table in the center. They exhibited a number of electrical sundries in a handsome show case, while on the wall at the back were arranged the various specialties handled by the firm such as annunciators, magnetos, and the Lockwood ammeter and polarity indicator. The exhibit was in charge of J. W. Mason, manager of the company.

The Bishop Gutta Percha company of New York, was represented by Ernest Hoefer of Chicago, who is their Western representative. Mr. Hoefer talked up their new double coated white core insulated wire and he created a very considerable demand for them. It is claimed that they are specially adapted for incandescent light work. The insulating material being applied by hydraulic pressure makes a perfectly homogeneous insulation which adheres so firmly to the wires that it cannot be removed unless scraped off. Of course this would render it entirely moisture-proof and would make it especially applicable for mining purposes, packing houses, and such work where the continued exposure to the gases and acids has a very injurious effect on all kinds of insulation. One of the special features of this brand is, that it is electrically welded and can be furnished to customers in any desired length.

The Royal Silk Manufacturing company of New York, was represented by A. J. Mayer. This firm is manufacturing a silk machine towel to take the place of cotton waste and claim that it has many advantages for wiping purposes over any other article in the market in that it absorbs every particle of oil on the machinery and leaves no lint. The towels are non combustible; can be washed from twenty to thirty times after use, which makes them cost fifty per cent. less than waste. In practical use a bale of these towels is claimed to be equal to 2,000 lbs. of cotton waste.

The Eddy Electric Manufacturing company were represented by A. D. Newton and M. E Baird. They had on exhibition one horse, two-horse and five-horse power motors all of their new type, the five-horse power motor being equipped with their new reversing apparatus making it especially adapted for elevator work. A five-horse power Eddy motor of the ring type occupied a position in the exhibit of English Morse & Co., running a 35 horse power Ideal engine The reversing apparatus of the five-horse power Eddy motor attracted a great amount of attention and certainly marks an advancement in the use of electric motors for passenger elevator service. The Eddy company since moving their shops to Windsor, Conn., have by reason of the excellence of their apparatus and their increased facilities, done an enormous business. They have recently increased their capital stock to $100,000 which will enable them to push the business more extensively than ever before.

The Edison Manufacturing company of Newark, N J., had on exhibition in charge of James F. Kelley, their New York agent, several of the new Edison-Lalande batteries. The elements of this battery are zinc, oxide of copper and a caustic potash solution. The oxide of copper is made up in the form of a plate and is clamped in a copper frame. The zinc plates are suspended from a binding post resting on the cover and hanging on either side of the oxide plate. The caustic potash is furnished in shape of sticks, two sticks accompanying each cell. These sticks are placed on either side of the zinc and the cell is filled with water within an inch of the top, a thin layer of oil is then poured over the top of the water in order to prevent formation of creeping salts. The internal resistance of the cell on exhibition was only .025 of a ohm. The e.m.f. on open circuit is about one volt, .8 of a volt on light closed circuit work and about .7 volt on heavy closed circuit work. Mr. Kelley stated that over 1,000 of these cells have been sold since January 1.

A very handsome display board of polished mahogany containing some fifty different samples of Habirshaw cores from ⅛-inch to 2⅛ inches in diameter, and from 5,000 to 700,000 circular mills was exhibited by the India Rubber and Gutta Percha Insulating company of New York. There were also shown standard cores of 00, 000 and 0000 for naval land cores, naval marine cores, feeder cables, three circuit underground cables, three circuit parallel and under-water cables. A very prominent core of this last kind was 2¾ inches in diameter, lately made and laid across the Delaware river at Easton, Pa. The company makes a specialty in addition to fine grades of wire for house wiring, of making cores and cables for power use, central station use, and also installations for all government work. Among the recent installations for the navy department are those made for San Francisco, Philadelphia, Baltimore, Chicago, and all recent cruisers equipped by the navy department. Among the recent large installations in New York are a number in which the specifications required that only the Habirshaw wire should be used, including the Metropolitan Museum of Art in Central Park, where the installation cost over $50,000, and other buildings among the finest erected in New York City this year, such as the Farmers' Loan and Trust company's building, corner Beaver and Union streets, Union Trust company's building, Broadway and Wall street, Merchants' Bank building and others. Mr. Habirshaw, the general manager of the company, is a well-known chemical engineer of high reputation, who has for many years, and is now acting chemist of the Produce Exchange in New York, and the New York Agricultural society.

The Electrical Supply company of Chicago, made a special effort in the display of their goods, confining the entire exhibit however to electric light materials. They occupied the room called "Department A" 35x20 feet on the right of the hall entering the Casino building. F. S. Terry was present and was assisted by Geo. F. Hewes. At the further end of the room was located a solid mahogany board containing a number of samples of underground cables, three circuit portables, sub-marine cables, naval land cores, three circuit underground, all of the celebrated Habirshaw rubber covered wire. This wire fully meets the United States specifications for marine work and is used on the new cruisers Chicago and Baltimore. The interior electrical conduit tubes were a prominent feature in the exhibit. Incandescent lamps, white and colored, Fletcher lamp hangers, non-sparking switches, detachable fuse boxes, arc light globe protectors, pocket current and pole indicators, electric portables, detachable rosettes and cutouts, Ellis oil filter, fuse wire of all kinds, high insulating brackets, standard testing sets and Wirts standard volt meter were a few of the specialties tastefully arranged in the room which was elaborately carpeted with Brussels and supplied with handsome antique furniture. Suspended from the ceiling was a Japanese umbrella on which were hung twenty-

five incandescent lamps of different colors forming a very pleasing effect. The room was perfectly ventilated by a small Electrical Supply company's ventilating fan motor. The messenger boys in attendance were all in uniform with a band on their caps marked in gilt letters "Electrical Supply company." Mr. Hewes brought with him a large number of posters and spent some time in billing the town. They also distributed a large number of their circulars as well as 20,000 samples of their shield brand wire, for which several large orders were taken during the session of the convention.

The display of the Edison Machine works of Schenectady, N. Y., was located in the north corner of the gallery. The exhibit was in charge of James F. Kelley, their New York agent. The exhibit consisted of samples of all kinds of covered wire for house and line work, double braided and rubber covered wire with smooth surface for house and line work, and the same wire with hard rough surface for outside, principally for tree work Flexible cords, rubber covered with silk or cotton outside in great variety of colors; annunciator and office wire; cotton covered magneto wire all sizes, silk covered magneto wire from No. 16 to a wire .002 of an inch in diameter; also samples of telegraph cables made up of 100 wires laid up in reversed layers, and samples of central station cable consisting of 931 No. 17 B. & S. wires; telephone cable with paper insulation consisting of 100 wires twisted in pairs and laid up in reversed layers; new solid rubber core wire not yet on the market, but which will shortly be ready for sale. Samples of paragon tape in all widths formed a part of the exhibit.

English, Morse & Co. of Kansas City, have taken great interest in this exhibition of the National Electric Light association which was practically shown by their handsome exhibit in Casino hall. This firm is one of the pioneer houses in the machine supply business and contracting engineers for building power plants in that section of the country. The present firm was organized in 1886, although all the members had been in the same business for ten or twelve years. They have a large and well arranged five-story building with basement, with the best of switching facilities. They represent a large number of prominent eastern manufacturers, among them A. L. Ide & Son, manufacturers of the celebrated Ide and Ideal engines; the Atlas Engine company of Indianapolis; Jewell Belting company; Shultz Belting company; American Leather Link Belt company; Hill Clutch works, and many others, and always carry on hand a full supply of the goods of all these houses. Their business extends throughout the entire southwest and territories. In their exhibit, which was located to the right of the entrance in Cssino hall, the first thing that struck the eye was a handsome Ideal high speed engine of 35-horse power in operation, being driven by a small Eddy electric motor, there being no steam connection in the hall. One of the fly wheels was fitted with incandescent lamps of different colors, current for which was delivered from a commutator on the engine shaft. When the engine was in motion the effect produced was that of alternate ribbons of light of variegated colors. A small model of the Ide engine waa also in operation, being run by a miniature motor. There was also on exhibition a complete stock of the Jewell belting of the various widths arranged in a pyramid. The various steam specialties handled by the firm were carefully arranged in their space and a large show case of their tools occupied a prominent position. Steam packing in large variety was a feature of the exhibit. The exhibit attracted a good deal of attention and showed completely the very excellent facilities at the command of this firm for the erection of all kinds of steam plants set up ready for use.

Noyes Bros., who are manufacturers of small electric fixtures, 85 and 87 Fifth avenue, Chicago, had sample boards showing their lines of goods, in the northeast corner of the room.

The Vulcan Manufacturing company of Kansas City and Hutchinson, Kan., showed one of its new patent grate bars which it is introducing to electrical companies

F. A. Magee of E. S. Greeley & Co., was in attendance at the convention, passing most of his time in the Casino Hall, greeting old acquaintances and talking up the company's specialties.

The New Haven Clock company had representatives from both of its leading houses, George S. Searing of New York and Charles G. Armstrong of Chicago.

The Jaccard Jewelry company of Kansas City exhibited a showcase, containing Paillard non-magnetic watches.

Emil Kahn represented the Cincinnati Electric Engine company, of which he is president, and was always ready to speak of the good points of their arc-light machine.

The Elektron Manufacturing company of Brooklyn had on exhibition a 1-horse power Perret motor, which was inspected with interest by visitors. It is handsome in design, and performs its work well.

E. L. Clark of Chicago was a little late in getting to Kansas City, but upon reaching the city he lost no time in speaking enthusiastically of the Walworth company and the other concerns, of which he is Chicago agent.

The Baxter Electric Motor company of Baltimore have reorganized their business, and were ably represented at the convention by David E. Evans.

The Western Electric company was represented by John Young, a veteran in electric lighting.

J. A. Pentz exhibited his electric meter at the Casino hall, and explained its merits.

The Empire City Electric company of New York was represented by David H. Chalmers.

The interests of Holmes, Booth & Holmes of New York, were looked after by H. P. Lucas.

The Pond Engineering company of St. Louis was represented by F. H. Pond of St. Louis and O. H. Schramm of Kansas City. They distributed a number of copies of their new journal, *The Western Engineer*, and had on exhibition a number of photographs of the Armington & Sims' engine, for which they are the Western agents.

The Monitor Electric company of Chicago, which has recently succeeded to the business of G. A. Harmount exhibited a number of its electrical specialties. C. G. Armstrong was the representative.

Charles E Gregory was present to speak of the merits of the Sperry dynamo and to represent the Sperry Electric company of Chicago.

The representatives of the Brush Electric company were Alex. Kempt of Chicago, and C. C. Curtis of Cleveland.

The merits of the Ball Engine company were presented by W. B. Pearson, the Chicago manager of the Ball company.

George C. Bailey of Chicago, had a small but complete exhibit of bare and covered wire, made by the John A. Roebling & Sons company, of which concern he is the Chicago manager.

The Parker-Russell Mining & Manufacturing company of St. Louis were represented by G. W. Parker, D. R. Russell and C. W. Hazeltine.

A. L. Ide of Springfield, Ill., manufacturer of the Ide and the Ideal engines was present, not only as a representative of the Springfield Electric Light company, but also to look after the interests of his engine firm.

J. C. Hobart, secretary of the Triumph Engine company of Cincinnati, brought with him to the convention a handsome model of the new Triumph engine, which was fully described and illustrated in the WESTERN ELECTRICIAN of February 8th. The model was exhibited in Casino hall, and was inspected with interest by the delegates.

The National Electric Manufacturing company of Eau Claire, Wis., exhibited a complete outfit, consisting of a 800 light Freeman alternating current dynamo, with transformers, and a switch-board with all necessary appliances. Carl Kammeyer, superintendent of construction, was in charge of the exhibit.

The Standard Paint company of New York, the manufacturer of the celebrated P. & B. for insulating purposes, was represented by F. H. Hoover of Kansas City.

The Weston Electrical Instrument company of Newark, N. J., exhibited a very complete line of all the standard electrical testing instruments made by the company, including the celebrated Weston direct reading voltmeter. The exhibit of these well-known instruments of course attracted the attention of the electric-light men generally. M. M Garver, manager of the company, was in charge of the exhibit.

The Detroit Motor company's exhibit was in charge of A. A. Robinson, and consisted of a 7½ horse power motor equipped with the Blades' automatic rheostat and switch combined.

J. W. Godfrey of the New York Insulated Wire company, was present at the convention, as usual. A fine exhibit of the company's wire made by the Kansas City representative, the Southwestern Electrical Supply company. Mr. Godfrey's time was largely taken up in greeting old acquaintances and in making new friends.

William Baragwanath & Son of Chicago, displayed several neat banners setting forth the advantages of their feed water heaters.

The Crocker-Wheeler Motor company of New York was represented in Casino Hall by Dr. S. S. Wheeler, who explained to all visitors the new regulating device which is now attached to all C.-W. motors.

The Eureka Tempered Copper company of North East, Pa., had a small but complete exhibit in charge of A. L Daniels. The exhibit consisted of commutator segments, journal bearings, rolled brushes and the Washburn trolley wheels and many other special drop forgings.

The Thomson-Houston Electric company of Boston was represented by Charles S. Rusling, Kansas City agent, and George Atkinson, Edwin Floyd and J. H. Stedman of the Chicago office. Though the company had no exhibit in the hall, its representatives invited delegates to call at the large Thomson-Houston central station in Kansas City.

The Royal Electric Specialty company of New York exhibited Lang's patent automatic current cut-out. By its use the company claims all accidents from broken wires may be avoided. The company also showed a safety floor insulator for carrying wire through floor partitions etc.

H. A. Glasier, who has recently opened an office in the Chicago Electric Club building on Adams street, Chicago, representing J. A. Grant & Co. of Boston, was of course at the convention, and was warmly greeted by old-time acquaintances, who predicted that his new business connection will be successful in every respect.

R. J. Randolph represented the Chicago office of the Excelsior Electric company.

The representative of the Sawyer-Man company at the convention was P. H. Alexander, who took an active part in the work of the association.

The Westinghouse Machine company was represented by H. E. Longwell, the Chicago agent.

The C. & C. Motor company of New York had an excellent location in Casino hall, at the left of the main entrance. The company showed most of the sizes of motors built by them, ranging from ⅛ to 20 horse power. H. L. Lufkin represented the New York office, and was assisted by Floyd Platt, the Kansas City representative.

S. H. Tallmage of Kansas City, exhibited an electric heater. The device was of the appearance of an ordinary steam radiator. The heater was connected with the secondary wires of an alternating system. The potential was 100 volts. Mr Tallmage says the heater will take about as much current as a 1-horse power motor.

The Westinghouse Electric company has installed a 750-light plant, alternating current system, at Sioux Falls, South Dakota.

Williamsport, Pa., has now an electric light plant of a capacity of 2,250 incandescent lamps. A new 750-light machine, Westinghouse alternating current system, has just been added.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 15.—The cry for rapid transit continues, but there is little prospect of any immediate relief. The agitation for the World's Fair has led many candid men in this city to wonder what could be done with the great crowds that such an attraction would certainly gather. This is not the most unimportant feature of the World's Fair problem. The monopoly that controls the elevated road opposes all improvements and has thus far kept electric roads out of competition. Electric cars look too much like speed and comfort, and it would not serve the purpose of this rich corporation to get the public to expect such accommodations. Another blot on the city is the question of subway conductors. It is a singular thing that no other city has such difficulty with its conductors. Here again city politicians show their hands. Already the excavations in the thoroughfares of the city have caused four-fold more deaths, by disease contracted from breathing the poisonous gases arising therefrom, than were killed by handling the wires attached to poles. If New York had lived up to her privileges as Chicago has done there would be no chance for such bumiliating confessions of neglected duties.

Mayor Grant sent to the fire commissioners Tuesday a list of the telegraph poles that now bear only fire wires and police wires, some of them being department poles and some poles abandoned by their owners, and useful only to carry department wires. The mayor says: "You will readily see that the above, together with a few others, which will be furnished to you by Mr. Wheeler would make nearly 1,000 poles which could be cleared from the streets if your department and the police department could remove their wires. I wish you would take up the matter and facilitate its disposal as much as possible. The representatives of the telegraph and telephone companies frequently make the excuse that their wires are down long before those belonging to the city." W. H. T.

Boston, Mass.

BOSTON, Feb. 14.—The principal event in electrical circles in this city last week, was the public hearing before the board of aldermen on the petition of the Suburban Light & Power company to erect poles for electric light wires in the suburban districts of Roxbury and Dorchester. This privilege was considered to be of great importance from the fact that it would, if granted, open the way for obtaining similar privileges throughout the city. The advent of this company was strongly opposed at the hearing, which continued through Monday and Wednesday afternoons, by the Boston Electric Light company now operating all the arc lights in the city, by the Edison Illuminating company, largely controlling the incandescent lighting of the city, and by many influential members of the Boston Board of Fire underwriters, and a large number of business men and prominent taxpayers. Quite an imposing array of legal talent was drawn up on each side Among the most prominent witnesses called were Prof. Henry Morton of the Stevens Institute of Technology; E. H. Johnson, ex-president of the Edison Electric Light company; Mr. Spencer of the Westinghouse Electric company, and Thomas Bicknell, president of the New England Portelectric company and representative in the State legislature from the Dorchester district. Prominent among the council was ex-Governor Gaston, who ably supported the Suburban company. At the close of the hearing the aldermen took the matter under advisement.

Two more corporations have sent petitions to the legislature for the right to construct elevated electric railways in the streets of Boston and vicinity. This makes about a half dozen such petitions now before the street railway committee

The Boston Electric Light company has applied to the proper authorities for permission to increase its capital stock by 20,000 shares, making its total capital stock $3,000,000, divided into 30,000 shares of $100 each.

Dustin Killicutt, inspector for the Boston Board of Fire underwriters, is advertising for electrical safety devices to be submitted for test to the board. By an arrangement with the various companies owning and operating electric wires in Boston, whatever devices are submitted will be subjected to tests upon circuits carrying the most powerful currents now in use in the city.

On December 18, 1889, the stockholders of the Thomson-Houston Electric company authorized the directors to issue and dispose of $3,000,000 of its 7 per cent. preferred stock. A part of this is now offered to holders of the common stock, the terms of subscription being that holders shall take at least $1,000 at par ($25 per share) and 25 cents interest, and that the Thomson-Houston company shall have an option on the stock at 28 at the expiration of one year.

Among the papers announced for the coming season fore the Boston Electric club are the following: "Legislation relating to the transmission of intelligence, light and power by electricity," by Arthur Lord; "Induction and interference with telephone service from electric light and power circuits, from a telephonic point of view," by W. J. Denver; "Single and double trolleys for electric railroads," by W. J. Mansfield; and "The relations between fire insurance and electric interests from the underwriters' standpoint," by S. E. Barton. O. H. M.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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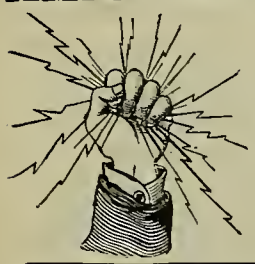

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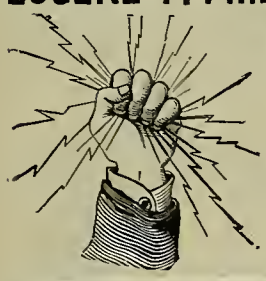

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THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: "**A Thoroughly Reliable and Desirable Wire in Every Respect.**"

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

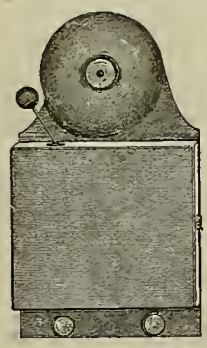
EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

—THE—

REDDING ELECTRIC CO.'S



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TO BE SOLD AT ACTUAL COST.

Having a larger stock of these goods on hand than we need at this season, we have decided to sell them at prices lower than were ever offered before.

All in need of these goods should apply at once to avoid disappointment, the price being so low that they are sure to be all sold in a very short time.

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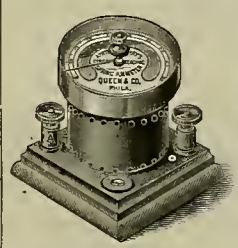
Standard Electrical Test Instruments.



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Electrical Supplies of all Kinds. SIMPLEX WIRE AND GRIMSHAW RUBBER COVERED WIRE ALWAYS ON HAND. Bottom Prices. Quick Shipments.

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INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

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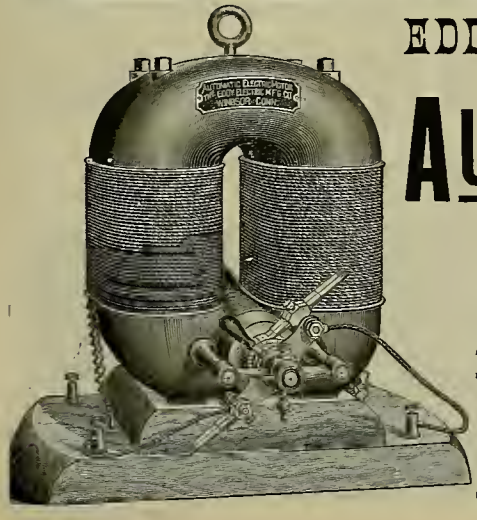

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DYNAMO ELECTRIC MACHINES

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GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

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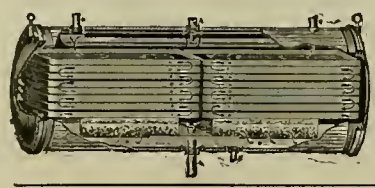

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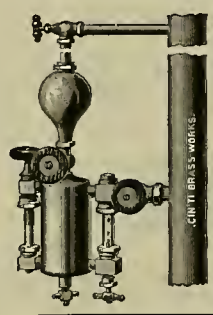

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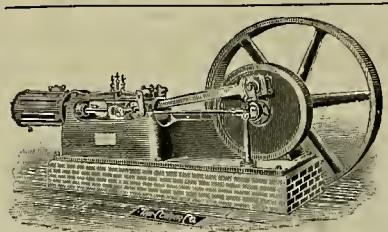

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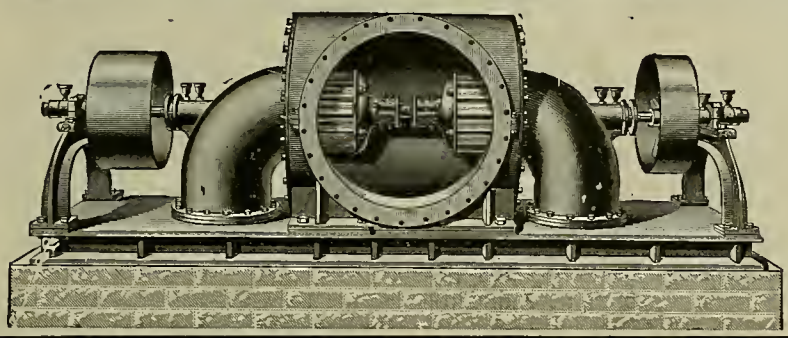

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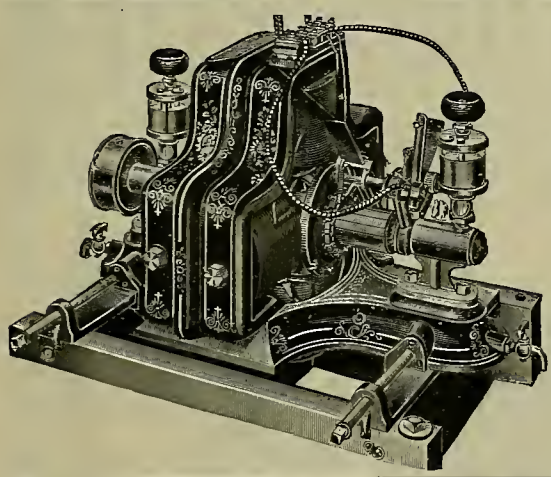

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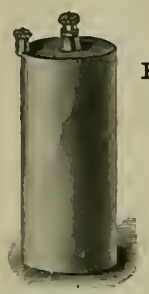

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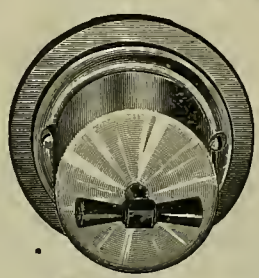

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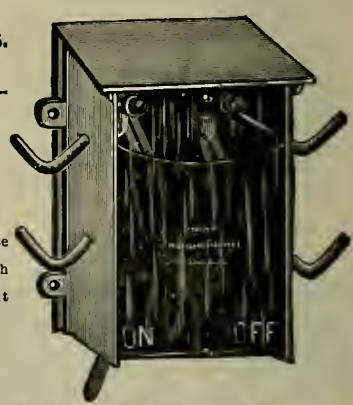

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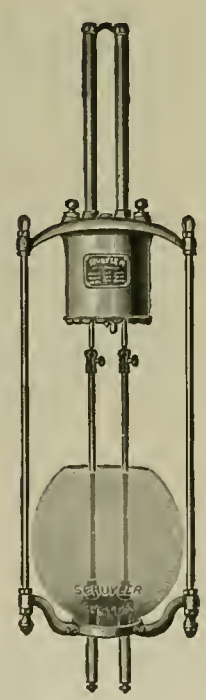

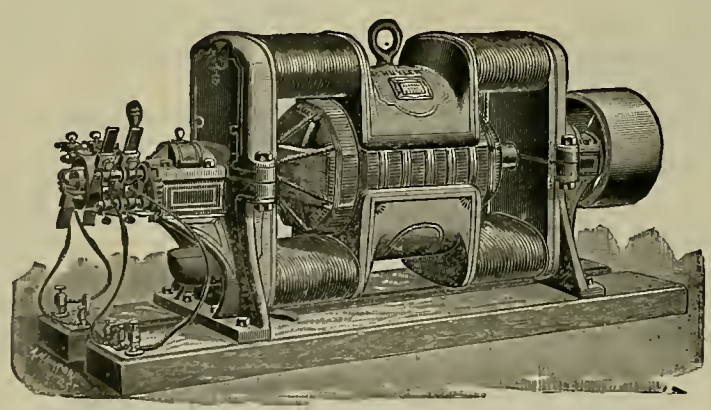

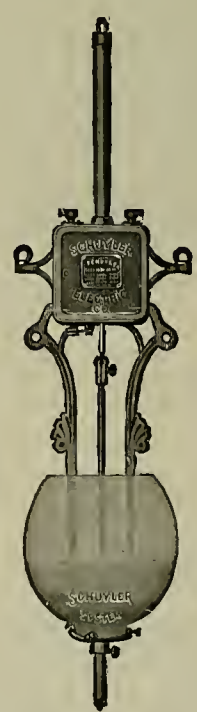

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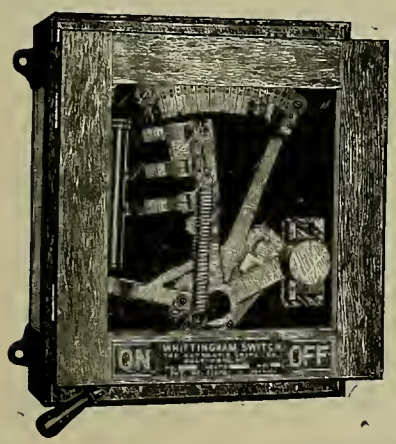

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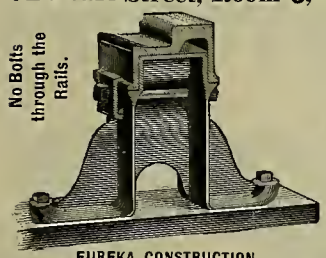

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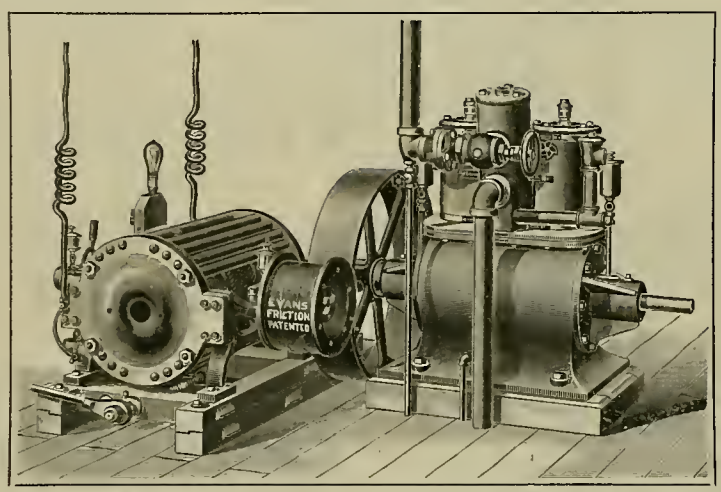

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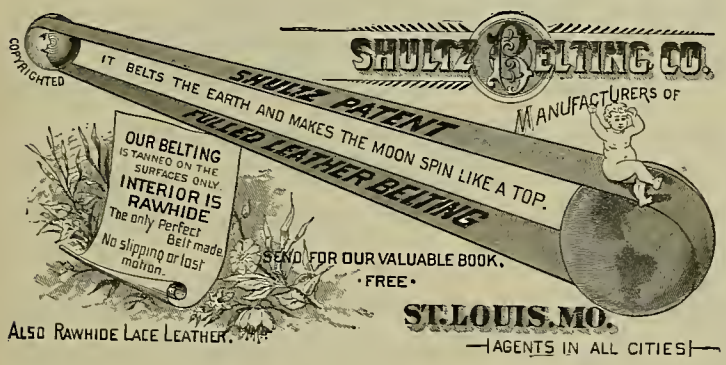

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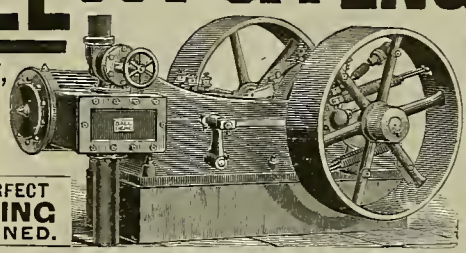

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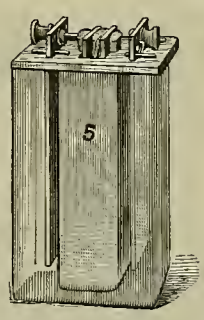

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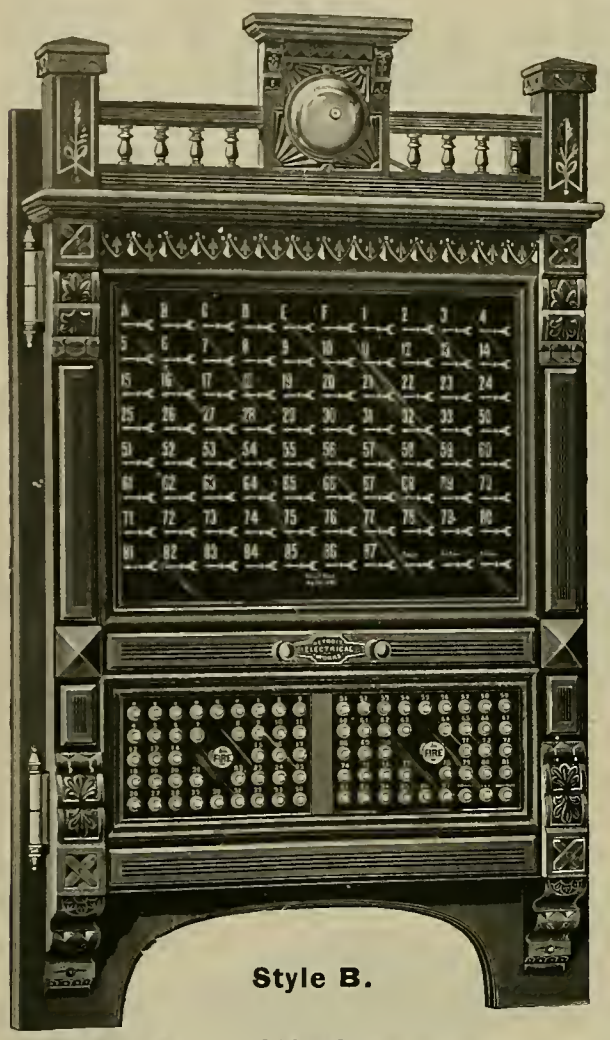

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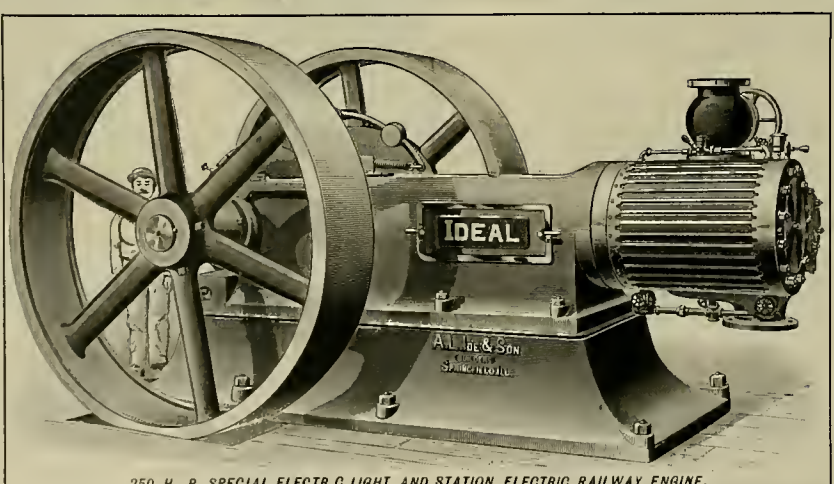

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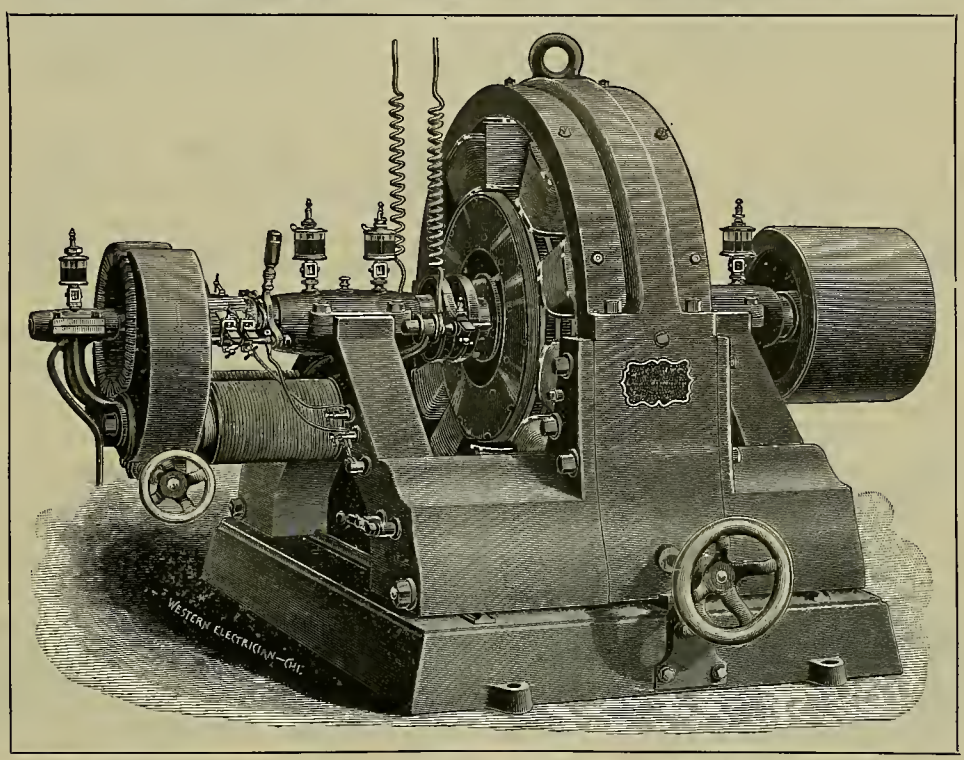

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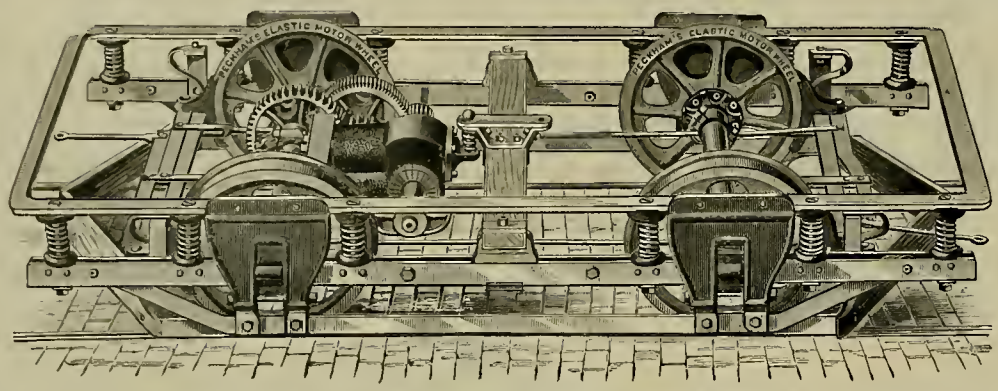

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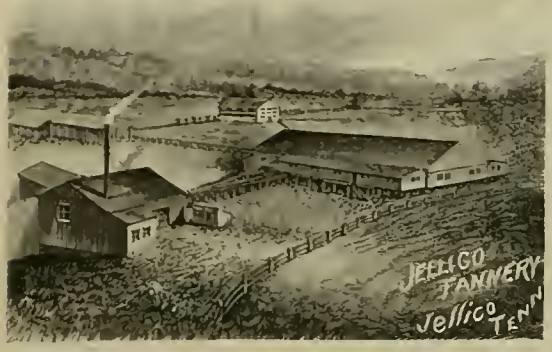

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JUDGE GRESHAM HOLDS:

1. *That Brush was the Pioneer Inventor in Commercial Arc Lighting.*
2. *That the Brush Patent in suit is the Pioneer Patent for Double Carbon Arc Lamps.*
3. *That the Patent is Broad and Fundamental.*
4. *That all its Claims (six in number) are valid.*
5. *That the claims of the Patent are all infringed by the Defendant.*

The Court says: "The separation of the two pair of Carbons, so that the Arc is established between one pair and maintained between the Carbons of that pair until they have been consumed and then automatically established between the Carbons of the other pair and maintained between them until they have been consumed, is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the Lamp in suit from all prior lamps."

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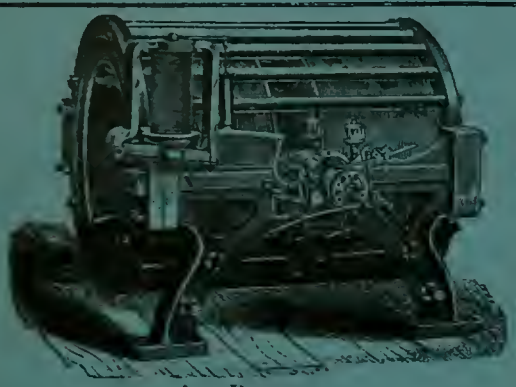

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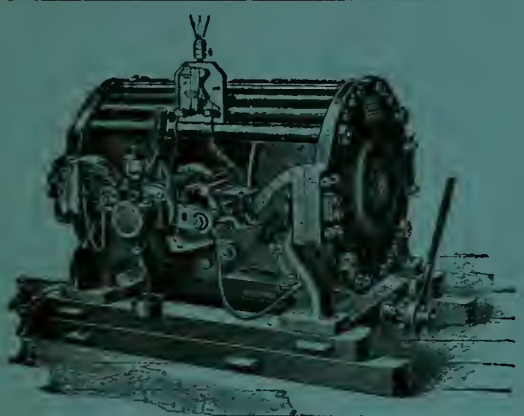
No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent., are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.



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Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.

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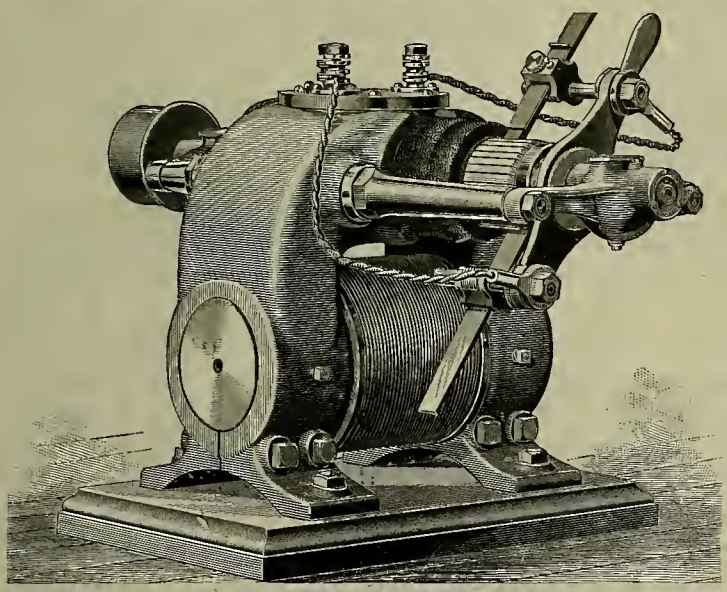

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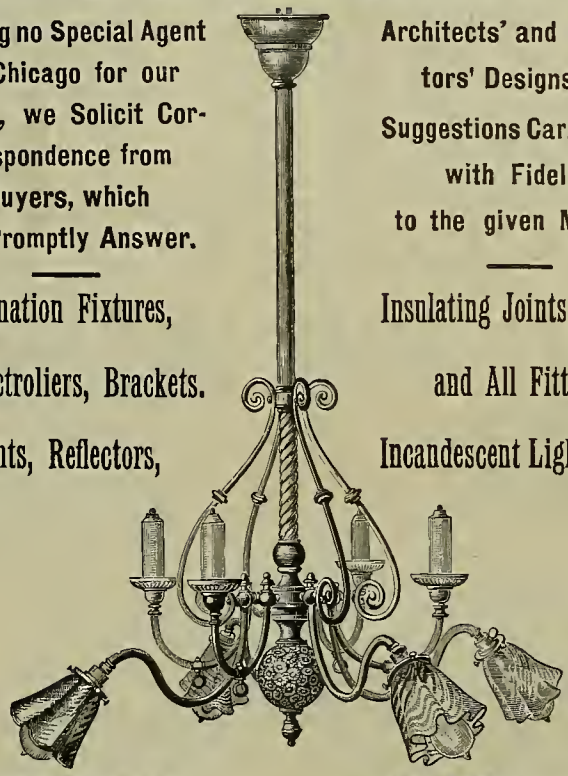

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Resistance	3,200	3,300	3,300	3,300	3,300

Time	30 min.	30 min.	30 min.	30 min.
Temperature	40° F.	115° F.	167° F.	200° F.
Resistance	3,900	162	12	5.2

The times given in the upper table are those between the immersion of the wire in water and the making of the test.

The times of the second table indicate the time between that at which the tank reached the indicated temperature and that at which the test was made.

The cable had been immersed in water for a month before the first temperature test was made.

It will be observed that the temperature being at 60° F. the resistance remained constant at its highest point for 24 days, and than raised greatly on lowering the temperature.

The lowering of resistance by a rise in the temperature is a common characteristic of all such insulations and indicates no defect. Most insulations are much more affected by this cause than was this one.

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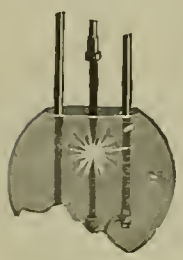

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These lamps, burning in series, require about 50 volts and 8 amperes of current.

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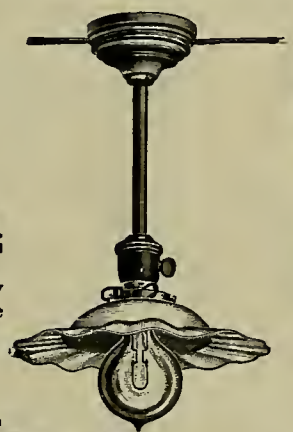

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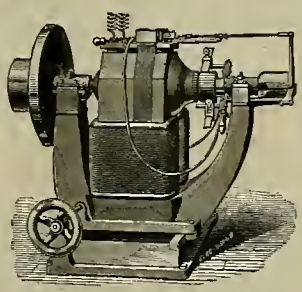

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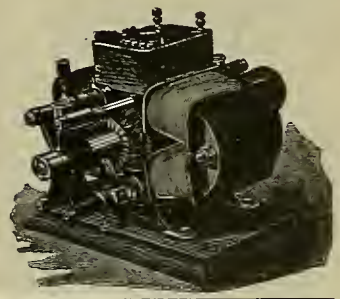

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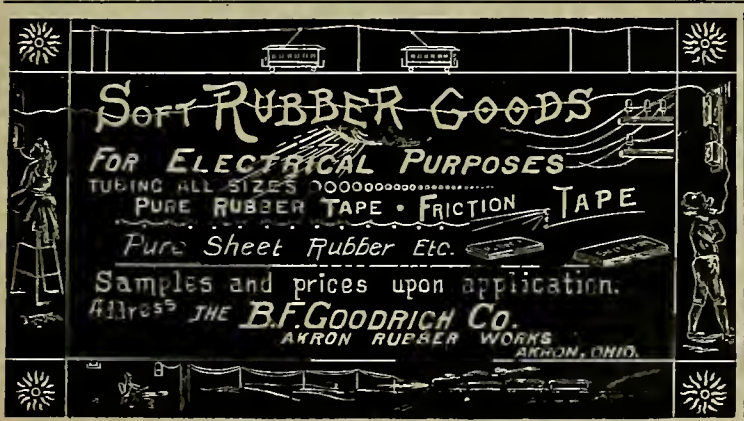

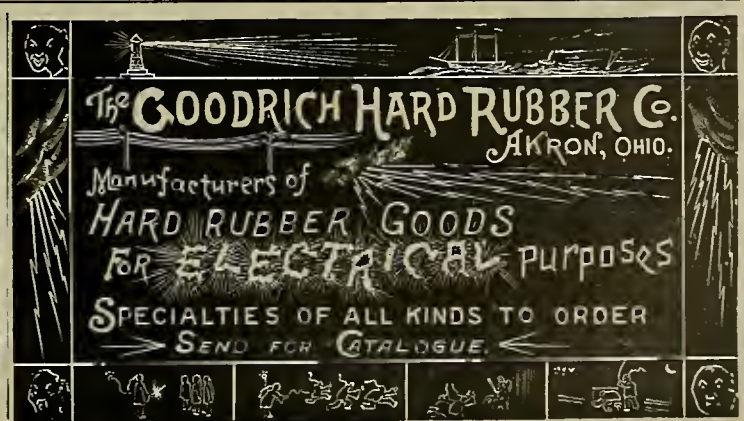

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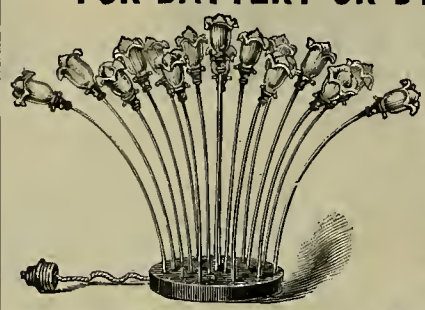

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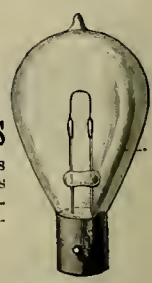

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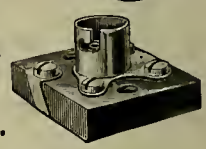

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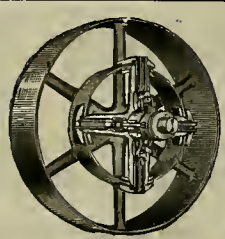

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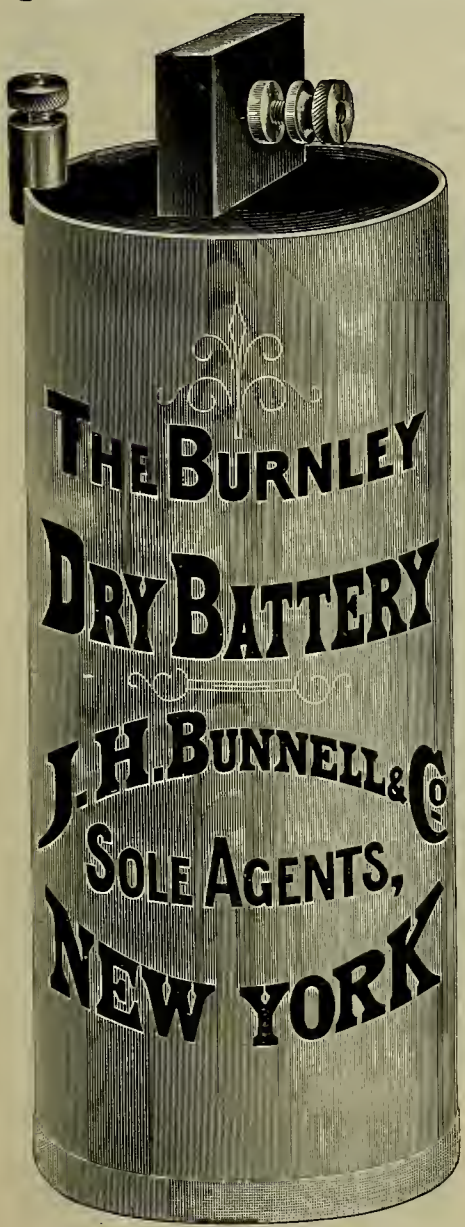

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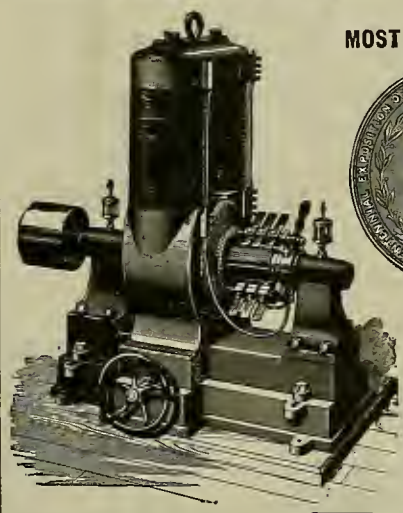

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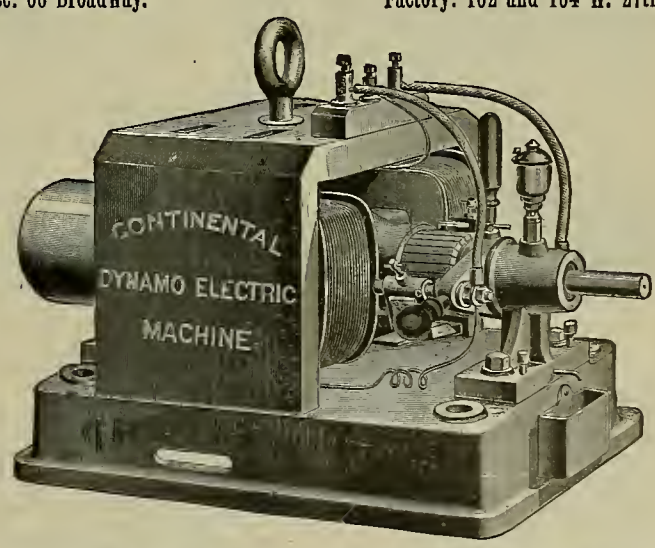

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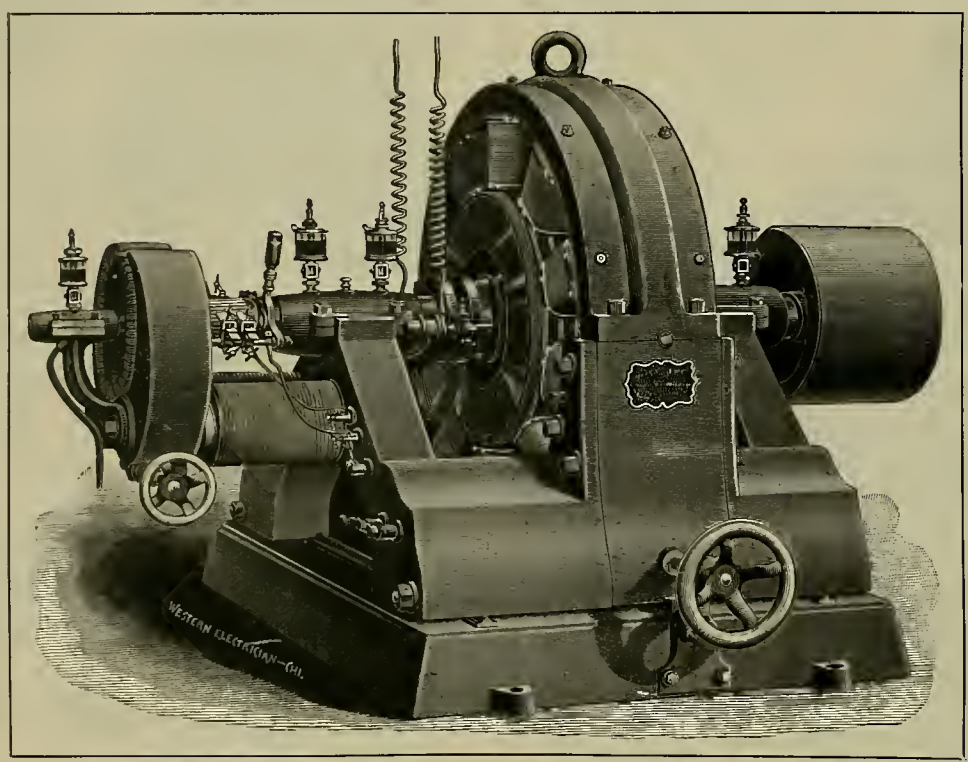

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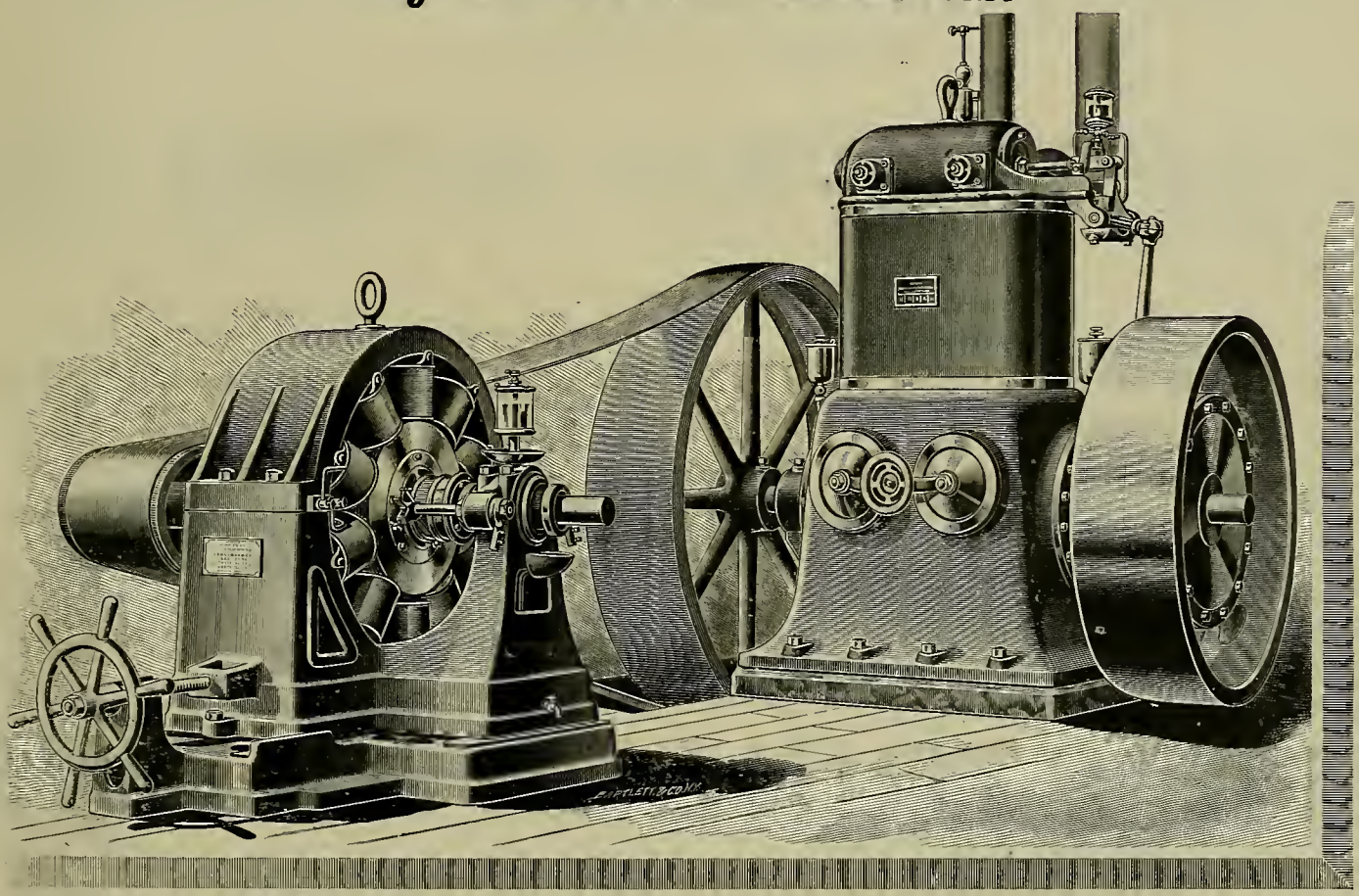

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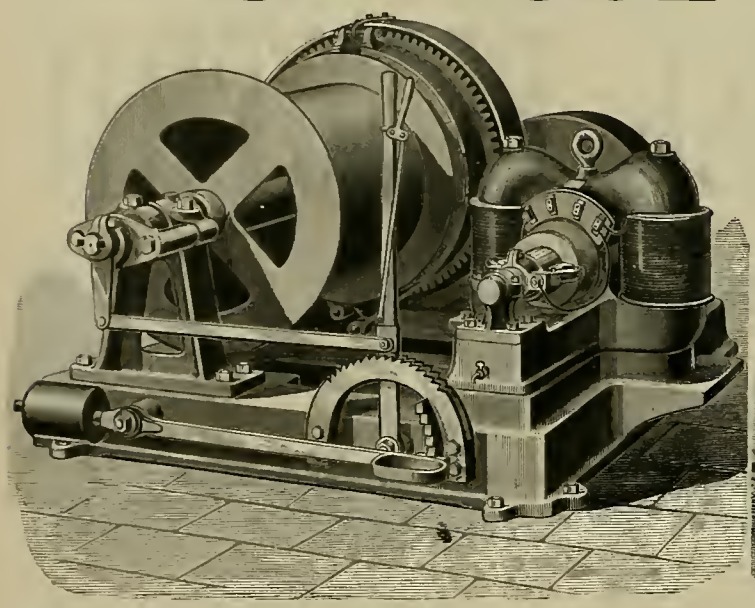

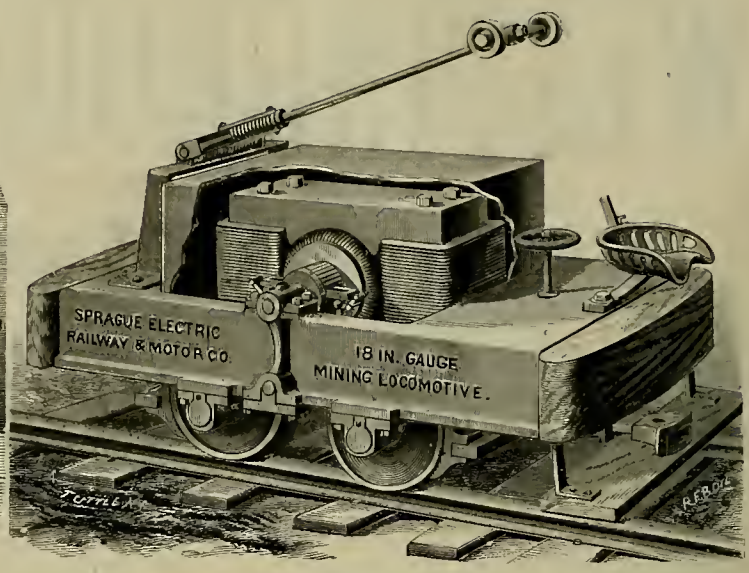

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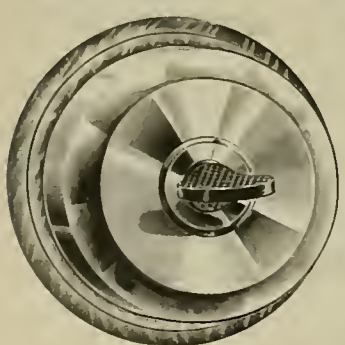

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Western Electrician.

EVERY SATURDAY.

Vol. V. CHICAGO, MARCH 1, 1890. No. 9

Electric Generators at the Chicago Office of the W. U. Telegraph Company.

The cuts presented herewith illustrate an interesting installation which has recently been made by the Western Union Telegraph company at Chicago. For several years the management at this point has been desirous of substituting dynamos in place of batteries as a means of supplying current for the operation of the lines. Owing to the fact that the Western Union offices are located in the heart of the city in a building already well filled, it was a difficult matter to find a suitable location for the proposed plant. Rooms were finally secured in a neighboring building, and work on the installation was immediately commenced. For the benefit of those who are not familiar with the arrangement of the Western Union main offices in Chicago, it may be stated that the batteries, to the total number of 25,000, are distributed about in the Union block and the building adjoining. From these battery rooms the current is conducted to the main operating room on an upper floor. The dynamos which are to take the place of the batteries are all located, as shown, in one room and are driven by motors Fig. 1. The plant consists of nineteen specially wound No. 2 Edison machines and three Sprague motors. Of these latter two are of fifteen horse-power and the third is of ten horse power. They are supplied with current from the Chicago Edison company's system. In addition to the ordinary starting switch, each motor has a special set of resistance coils which may be connected in shunt with the series coils of the motor. By the use of this resistance it is possible to compensate for the increase of speed due to the heating of the fields. The speed of the motors is 1,400 at 220 volts. The countershaft, two and one-half inches in diameter, runs at 400 revolutions and drives the dynamos at 1,250. The dynamos, nineteen in number, are all of the same size and are apparently the ordinary Edison No. 2 machines. They are however, as was before stated, specially wound for telegraph service. Referring to the diagram, Fig 2, it will be seen that the dynamos are arranged in three groups designated by A, B, and C.

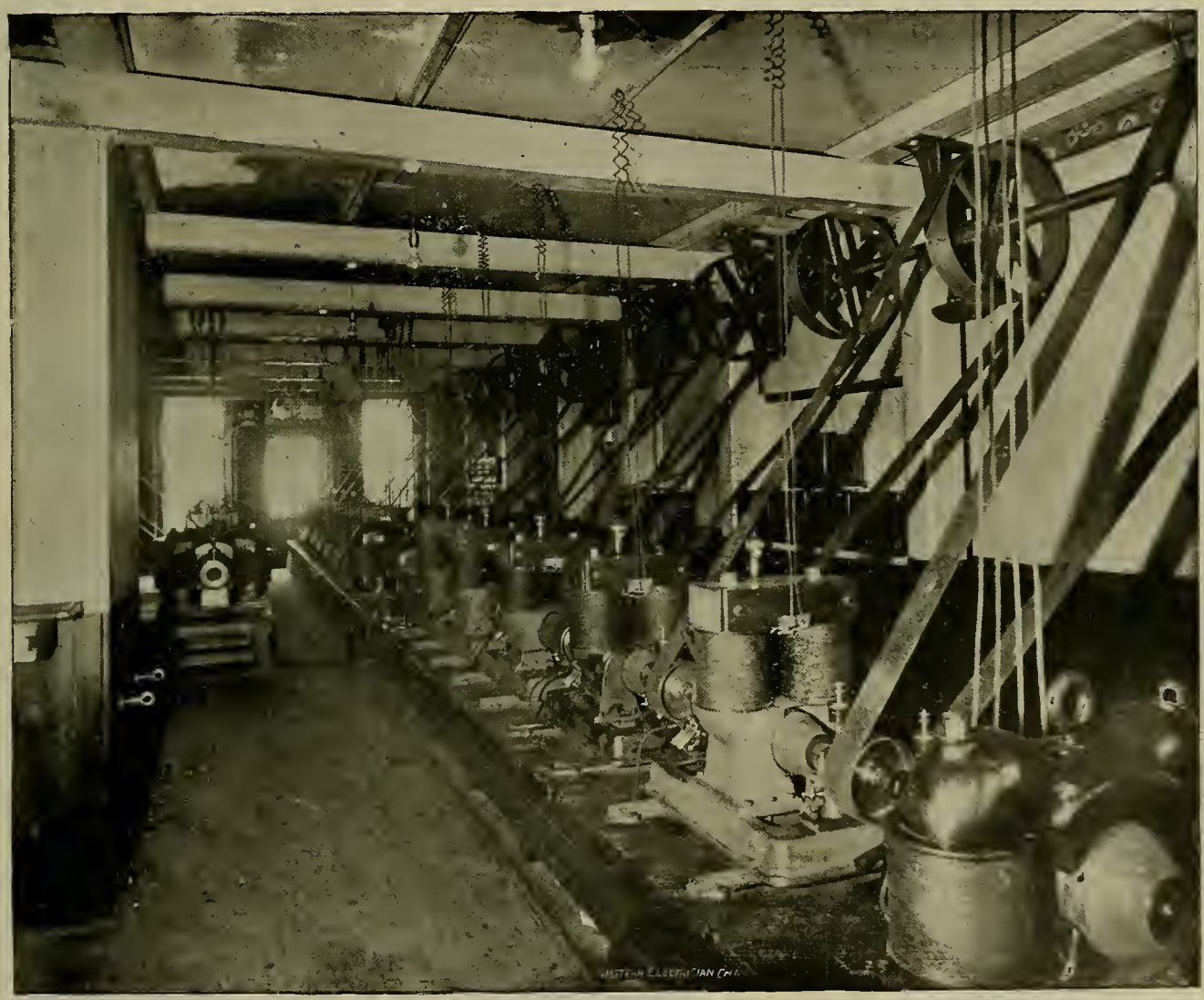


FIG. 1.—ELECTRIC GENERATORS AT THE CHICAGO WESTERN UNION TELEGRAPH OFFICE.

In group A there are seven machines and one fifteen horse power motor. Group B is identical with group A. The set of machines marked C, is composed of a ten horse power motor and five dynamos. The voltage of each dynamo is indicated in the diagram. The fifteen machines marked seventy are wound for 125 volts at 1,800 revolutions, but in the present instance they are run at 1,250 and supply forty amperes at seventy volts' pressure. Two of the four remaining machines deliver, under full load, seventy-five amperes at twenty volts, while the other two have each a capacity of 125 amperes at seven volts.

The seven-volt dynamos are for local service, that is, for sounders, pole changers, single transmitters, etc. It may be mentioned also in this connection, that the local instruments are now wound for fifty ohms' resistance instead of four ohms as was the usual practice where the batteries were used.

The twenty-volt dynamos furnish current for the "loop circuits," that is, such circuits as run to the Board of Trade and important branch Western Union offices.

The sounders and other local instruments are

connected in multiple. Each operating table, upon which there are from four to six instruments, is provided with a "Plush protector,' i. e., magnetic cut-out, and each wire which supplies several tables, is provided with a fusible strip.

The seventy-volt machines are used on high resistance lines. An inspection of the diagram will give the reader a general idea of how these last dynamos in groups A and B, are connected for service. Tracing out the connections it will be seen that the machines of both sets are in series. It will be noted, too, that the + terminal of series A is grounded, as is also the — terminal of series B. Between each dynamo a connection is made and a conductor is led thence to what might be termed a "bus" bar. The wires from the main switch-boards connect, through incandescent lamp resistances, with these "bus" bars. By this arrangement, it will be readily seen, it is possible to work a line at a potential ranging from, say, seventy to 280 volts and from either a + or a — generator terminal. A portion of the current from each machine marked E, is used to excite the field magnets of dynamo, E, and those of the remaining dynamos in the set. In other words, E is shunt-wound and the field magnets of the other machines in the series are connected in multiple across E's terminals. The grouping of the machines in the manner described and providing a set, C, as a reserve, makes it practically impossible for an ordinary accident to cut off the current from the system. The Western Union company estimates that a saving of about $16,000 per year in the cost of maintenance alone, will be effected by the adoption of this new generator system. The specifications for this plant were drawn up by L. L. Summers, assistant electrician of the central division of the Western Union Telegraph company, and the entire installation was made under his supervision.

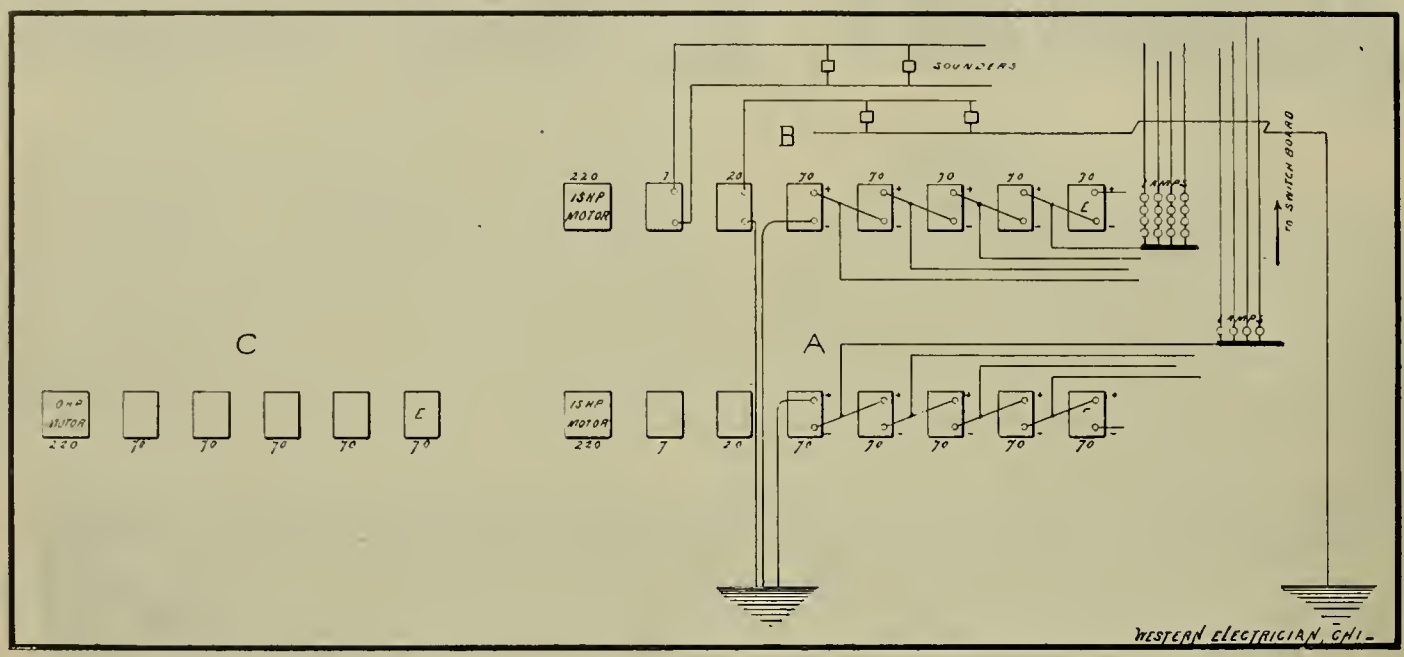


FIG. 2. ELECTRIC GENERATORS AT THE CHICAGO WESTERN UNION TELEGRAPH OFFICE.

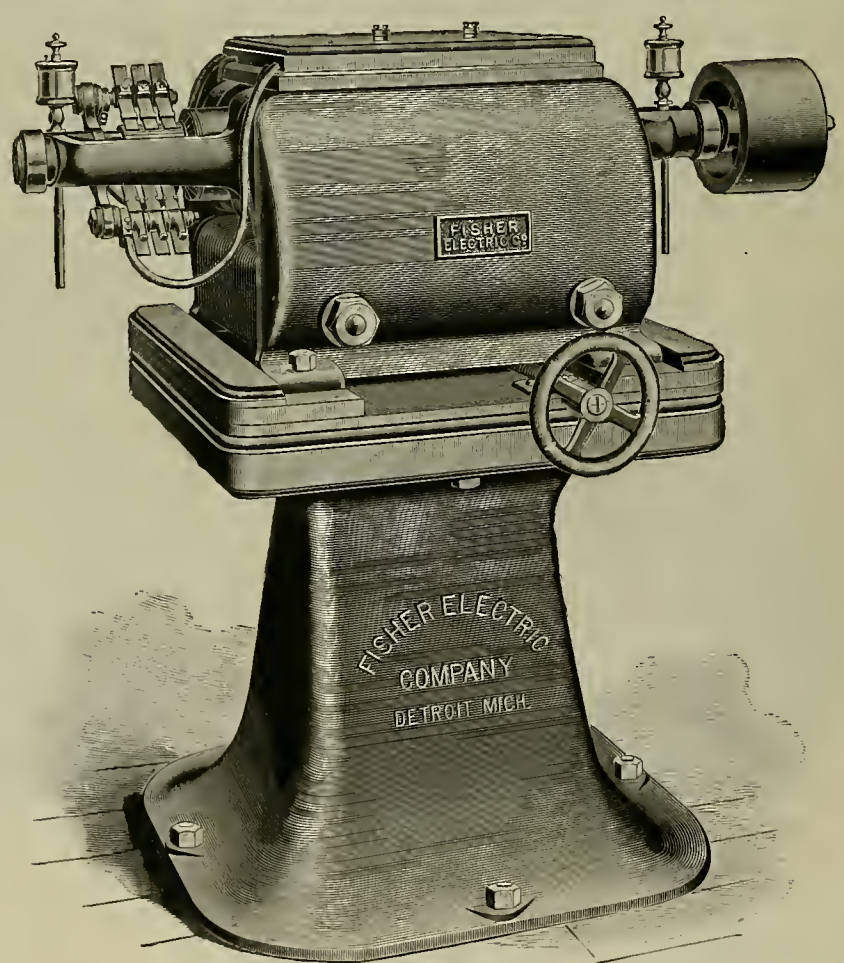
Fisher Incandescent Dynamo.

The Fisher Automatic incandescent dynamo is shown in the accompanying engraving. The machine is mounted on a heavy cast-iron bed-plate, a strong oak base being interposed between the dynamo and bed-plate. The machine is moved in either direction by the hand-wheel. The generator is a single field machine, the shunt coil being placed below the armature as shown, and the regulating coils being wound on the pole pieces embracing the armature. The shaft bearings are supported by heavy cast-iron projections which are bored concentric with the pole pieces. The bearings proper are made of small brass cylinders which are lined with babbitt and can be removed from the machine at any time, and new ones substituted at slight cost. The bearings are secured in position by heavy clamping nuts which compress the cast-iron extensions upon the bearings, rigidly securing the upper part of the machine.

The brush-holders are supported in the usual manner. The brush yoke, however, is cast on the front box and is held rigidly in one position.

This arrangement dispenses with all clamping and adjustment screws, and simplifies the machine greatly. The tension springs controlling the brushes are placed in a tube thoroughly protected from mechanical injury, and when tension is once applied can not be tampered with.

The machine is provided with sight feed oil-cups and the terminal connections are all made on a hard wood base which is covered with a second hard wood base, exposing only the line binding posts. There is no sparking at the brushes, and the machine is automatic from full to no load, and the use of rheostats and other manual regulators is not required. All the parts of the machine are interchangeable. The dynamo is manufactured by the Fisher Electric company of Detroit.



FISHER INCANDESCENT DYNAMO.

Electric Railway at Chicago.

An ordinance will be introduced into the Chicago council at an early day granting a franchise to a street railroad company to build and operate an electric street railway on Sixty-third street. A petition is now in circulation among the taxpayers on the route which it is proposed to take, and it is said the plan is meeting with the approval of all who are interested in the development of that part of the city. The territory through which the road will pass lies between State street and the Stickney tract. It is hoped the road will be completed by June 1st, and it is said that a storage battery system will be employed.

Automatic Electric Heat Regultaion.

In dwellings and moderate sized buildings, heated by hot air, hot water or a small steam boiler, it is usual to secure regulation by means of draughts and dampers, unless the heater uses some gaseous or liquid fuel, as natural gas or petroleum, when it is proper to control the supply material. In extensive high pressure steam heating plants, the steam is admitted or excluded from each radiator, in accordance with the temperature of the space heated by it.

The system here described abandons all indirect sources of power. Its several parts are a mercurial or metallic thermometer, arranged to make electric contacts whenever the temperature varies from a given degree—a four cell battery, of ordinary open-circuit sal ammoniac zinc-carbon type, and a small electric motor of a familiar type, or of a specially designed "ratchet" form. The motor is geared to a short shaft. The shaft at one end carries a crank or other device suitable for moving valves, draughts and dampers; and is so constructed at the other end as to operate a disk switch, which, though extremely simple, is perhaps the most inportant feature of the system. To this switch are connected the thermostat, battery and motor. Whenever a contact is made at the thermostat the switch operates first to start the motor, then to cut the thermostat entirely out of circuit; then to cause the motor to move independent of any control of the thermostat properly to shift the valves or dampers, when it finally breaks the circuit, the motor stops and the thermostat is put into control again.

Fig. 1 shows a moderate sized thermostat containing a bar of steel and rubber, one end of which is firmly held; the other end plays between two suitable contact screws, and moves to the right or left in accordance with the rise or fall of the temperature. By means of an arrow and scale, the thermostat may be set to any desirable degree, and whenever the temperature varies slightly from this point, the proper electric contact is made.

From the thermostat, wires are run to the disc switch of the motor shown in Fig. 2. It is an intermitting magnet "ratchet" motor, weighing ten pounds, and with the current of four cells will raise from fifteen to twenty pounds dead weight three inches for each half turn of the shaft. The disc switch used in this device is constructed so that for every contact of the thermostat the shaft will make half a rotation, and then come to a stop.

From the crank of the motor, chains are run as indicated in Fig. 3 to two swivel doors, shown in detail, one at Fig. 4, a box like casting called the "draught" door, which is clamped to the ash pit door of the furnace, and serves to control the admission of air to the fire.

Fig. 5 shows the "check" door, fastened to the discharge flue, which when opened, materially checks the force of the draught. These doors are connected to the motor crank so that one is open when the other is shut. They balance each other, so the motor has only to overcome their friction. Now suppose these are parts attached to a hot air furnace and the thermostat is set for seventy degrees. As long as the rooms are too cold, the crank remains at rest, holding the draught door open and the check door shut, and the fire is livened. As soon as the temperature reaches seventy degrees, the crank makes a half revolution and rests with check door open and draught door shut, deadening the fire. When the temperature falls one-half degree, the draught door is again opened, and thus the regulation proceeds.

In a hot water heater the temperature of the water must be taken into account. If a regulator is applied just as indicated for hot air, and the weather is unusually cold, the draught door will be held open continuously. The temperature of the water rises to 210 degrees, and is then distributing all the heat it can as water.

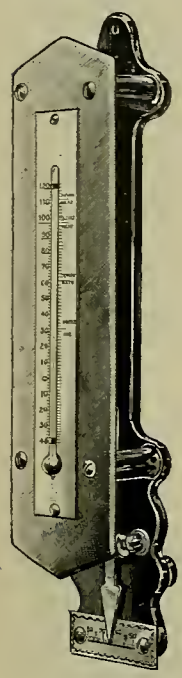


FIG. 1.

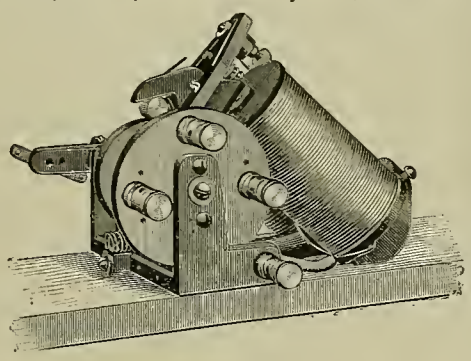


FIG. 2.

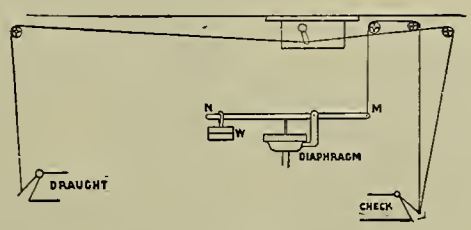


FIG. 3.

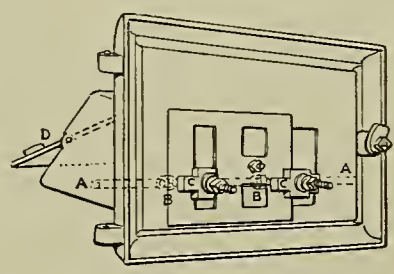


FIG. 4.

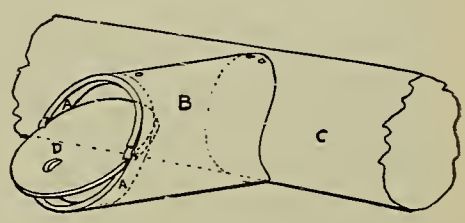
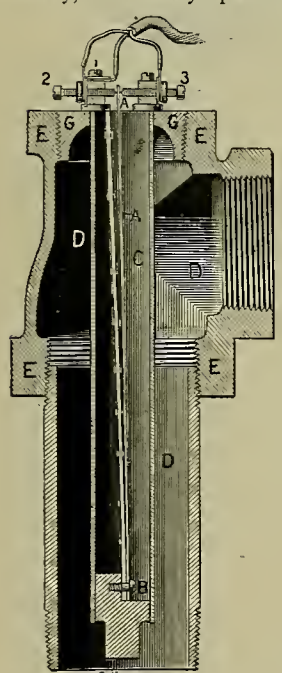


FIG. 5.

AUTOMATIC ELECTRIC HEAT REGULATION.



FIG, 6.

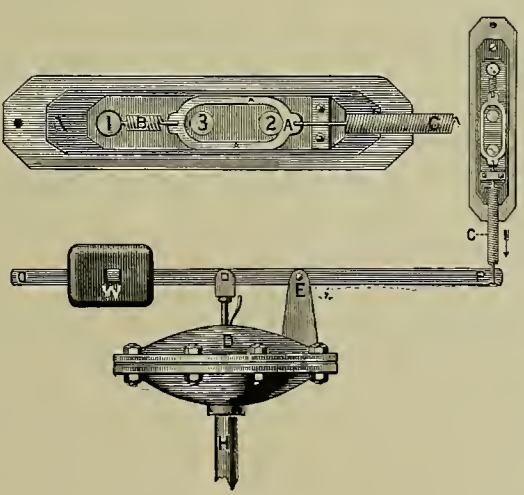


FIG. 7.

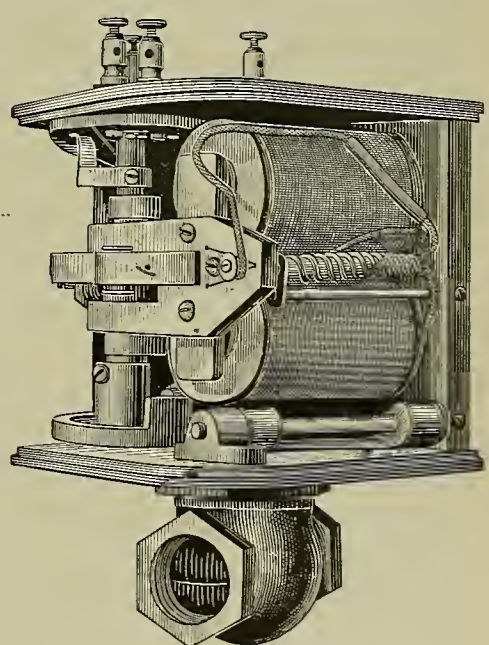


FIG. 8.

AUTOMATIC ELECTRIC HEAT REGULATION.

Increased temperature means steam and the generation of steam involves the forcing of the water out of the system, and the heater becomes useless. Fig. 6 shows a supplementary device for hot water heaters The other parts of the regulator are applied as described for hot air. This contrivance is a jacketed thermostat, which is subjected to the temperature of the water. Should the apartment thermostat for any reason keep the d aughts on continuously so that the water is near boiling, the fire will be checked by the interfering action of this device. If necessary on a cold day, the water will be maintained at 205 to 210 degrees without danger of boiling.

A somewhat similar condition is found in steam boiler heating by low pressure, i. e., not higher than three or four pounds. When that pressure is obtained the radiators are doing as good work as they would do on twenty or thirty pounds. Suppose a steam boiler has been regulated through the night for sixty degrees. In the morning, the thermostat is set at seventy degrees, and the draughts are at once opened. Now, the temperature of the house is to be raised ten degrees, and this will require much longer time than is necessary to get three or four pounds steam pressure. If the draughts are kept open continuously till the house is warmed, the pressure will attain to twenty or thirty pounds, or even more, and it is necessary to use the device shown in Fig. 7 to hold the steam at three or four pounds while the house is warming. Steam heating boilers are provided with a "diaphragm" regulator, which maintains a constant pressure, however much the requirements may vary from hour to hour. When the house is slightly cold, a little steam is needed; when warm enough, no steam at all; and when decidedly too cold, three or four pounds, but no more is required, and all these variations may occur during the course of two or three hours.

To accomplish these results on steam heaters, the regulator is applied as indicated in Fig. 3 and as described for hot air. In addition the "diaphragm" lever is left connected with the "check" dampers, and is also utilized, as in Fig. 7, to actuate an interfering device, which causes the motor to check the fire if the pressure exceed the amount for which the weight W is set, and also acts in conjunction with thermostat in the apartment, to maintain that pressure as long as the house is too cold.

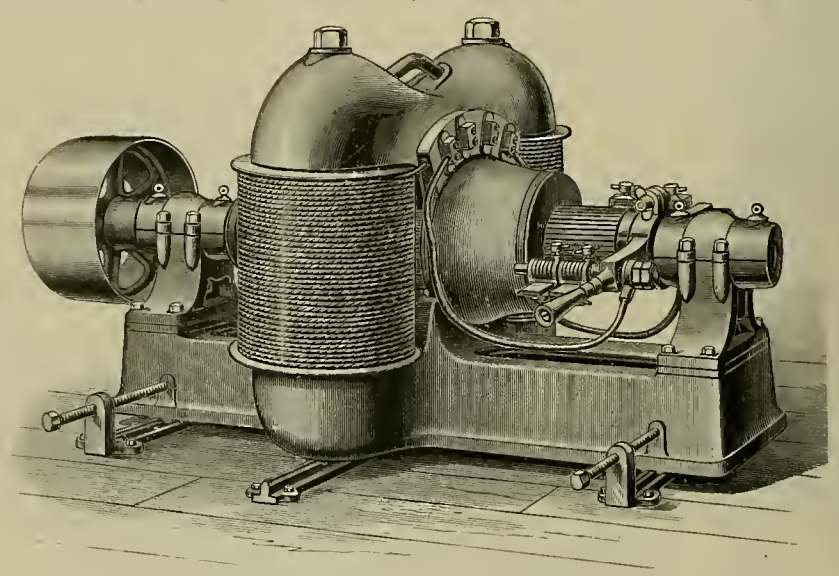
When the heater uses a liquid or gaseous fuel, two pipes are run to the burner. In one pipe is placed a hand valve, which is permanently opened only sufficiently to maintain a small flame at the burner. In the second pipe is placed an "electric valve," which is controlled by a thermostat, and is either fully open or completely shut, causing the intensity of the flame to vary according to the changing temperature, and limiting the quantity of fuel burned to that actually required. Fig. 9 shows a valve which may be used for that purpose, but this valve is more particularly adapted to be used with a thermostat for temperature regulation of high pressure steam. Its construction is sufficiently well indicated in the cut. A motor is geared to a shaft which bears at one end a cam for opening and shutting a valve, and at the other end is a disk switch of little different construction from the one used in Fig. 4, but performing similar duty. The valve proper is a globe valve of ordinary construction. The steam pressure is admitted above the valve, and prevents any leakage by holding it fairly to the seat when the valve is shut.

In regulating high pressure steam, a thermostat is placed in the apartment heated by a coil or radiator, and an electric valve is placed in the corresponding steam supply pipe. If it is a two pipe system an ordinary check valve is placed in the return pipe. When the room is too warm, the electric valve is closed and the check valve shuts automatically by pressure so that the steam is excluded from the radiator, and when the room cools slightly the steam is admitted again. Thus the steam supply to each radiator is governed by the temperature of the space it heats.

Open circuit batteries sometimes are short circuited and spoiled, and this fact constitutes the weakest point in any appliance using such cells. This short circuiting or grounding is guarded against in the regulating system above described, by the use of a cut-out, which is automatic and sure in its action, and acts to completely break the circuit if it be maintained continuously longer than about thirty seconds. The system of heat regulating described is that of F. M. Sparrow, Boston and Mattapoisett, Mass.

Sprague Fifty-Horse Power Motor.

The tendency among the leading electric motor companies seems to be toward increasing the size and capacity of their machines. It was not a very long while ago when a 30 horse power electric motor was considered large. Since that time the Sprague Electric Railway & Motor company of New York has put upon the market a 75 horse power motor, which is probably the largest electric motor in ordinary commercial use. In the accompanying cut is illustrated a new 50 horse power motor manufactured by the Sprague company, which has given very good results in practice. As can be seen by the illustration, the motor is similar to other machines manufactured by this company. The efficiency of this machine is high, and great attention has been paid to the mechanical and electrical construction in order to allow the machine to give a high output as well as to make it as durable and reliable as possible. The motor is automatic in operation, regulating for a constant speed with varying loads. The governing device is entirely in the winding of the motor, and consequently there are no mechanical governing parts to get out of order. Self-oiling bearings are used, by means of which a thorough and complete lubrication of the armature shaft is maintained.



SPRAGUE FIFTY-HORSE POWER MOTOR.

Chicago City Electric Light Plant.

An addition of 150 arc lamps was made to the plant of the city of Chicago last Saturday night. These lamps are located in the north division of Chicago and are supplied with current from the new station on Chicago avenue. Six thirty-five light Thomson-Houston machines are already in position and more will be added until the number of lamps supplied from this station reaches 500. The circuits already connected with this station are arranged so that 400 lamps can be supplied without additional conduits. The two remaining power houses are not yet completed and they have not therefore passed into the control of the city electrician. As soon as they are turned over to him he will install the electrical machinery and as the lamp posts are erected and everything is in readiness, connections can be made and the station started up within a week.

The finance committee of the Chicago city council has been considering the estimates furnished by the several city departments including the electrical branch. Prof. Barrett said he could conveniently use $750,000 in extending the city plant next year. The chairman of the finance committee was reported in a daily paper as saying that he would not recommend the appropriation of a dollar for the electrical department until that of last year was accounted for. The same article contained what purported to be an explanation by Prof. Barrett and to give the alleged interview an air of reliability figures were introduced but these to any one acquainted with the facts would excite suspicion. Alderman Dixon has since denied all responsibility for the statement personally to Prof. Barrett and this seems to be sustained by the fact that the statement attributed to Prof. Barrett is without foundation. What the city electrician did say, was, "If Dixon wants to know anything about the affairs of this office, he knows where to get the information. As chairman of the finance committee he has access to the accounts of the department, and he knows it. I don't propose to make any account through the newspapers, and I am surprised that Dixon should make such a statement." It is evident that the whole affair is the outcome of political differences. The paper which contained the article is opposed to the present city administration and has persistently attacked every department of the city government. Mayor Cregier forbade the heads of departments furnishing statistics for publication and ordered the officials to report to him. City Electrician Barrett in common with other city officials has made his report and as the newspapers were thus deprived of several valuable items they are not feeling very friendly toward the present administration.

Two Million Dollar Electric Railway Contract.

During last week Thos. Lowry, president of one of the largest street railway combinations in the world, showed his confidence in the electric system of street railway propulsion by deciding to equip all the lines of St. Paul and Minneapolis by electricity. The contract was awarded to the Sprague Electric Railway & Motor company, and the investment required for the equipment is said to be in the neighborhood of $2,000,000. The contracts for the partial equipment of the road by cable were cancelled, and negotiations were entered into with the Sprague company for the entire electrical equipment.

By the terms of the contract the Sprague company is to fully equip and put into working order the entire mileage owned by the railway company, the work to be completed by June 1st, and the first delivery of electric railway apparatus, which will include 400 Sprague improved motors for the equipment of the rolling stock, will be made shortly.

This is one of the largest orders ever given for electric railway motors, and evinces the confidence which prominent street railway managers feel in the electric system.

The Marquette Electric Construction company, Chicago, has been formed to operate electric machinery for the purpose of furnishing light, heat, and power; capital stock, $25,000; incorporators, Alfred L. Baker, Samuel S. Parks, and Eben F. Runyon, Jr.

Practical Working of the Electrical Subways of New York City.[1]

By William Maver, Jr.

Part I.

Knowing very well the widespread interest that has attended the placing of wires underground in New York city, I have been glad of the opportunity to gather and prepare for presentation to you this evening, such data and information relating to that subject as I have thought would be and as I hope may be found of the most value.

I observe that our worthy secretary has announced me on the notice of the meeting as the electrician of the Consolidated Telegraph & Electrical Subway company—and quite correctly so. I desire to say, however, perhaps unnecessarily, that I have prepared this paper in my unofficial capacity and am of course alone responsible for what may be contained therein.

The customary reply to an inquiry as to what is the best arrangement for an electrical subway is, "Build a tunnel under the streets and place the wires on the wall within easy access of workmen and into such a tunnel put also the gas and water mains, etc."

Assuming that this would be a satisfactory solution of the underground question if it could be arranged, let us consider what the cost of such an arrangement would be.

It has been estimated that a subway suitable to contain all the electric wires, gas and water mains of New York city would cost $430,000 per mile. This for Broadway alone from Bowling Green to Central Park would mean an outlay of about $2,150,000, and if such a tunnel were to be built throughout the entire route of the now existing electrical subways of New York city, the bill would foot up to nearly $30,000,000.

This amount, it will, I think, be generally admitted is virtually prohibitory of any such subway at present, and if that is the case, the fact will perhaps make those who have had preconceived ideas in favor of a universal tunnel scheme more tolerant of the electrical subways we have, the practical working of which I am to endeavor to describe this evening.

When the first whisperings of a desire on the part of the public or press to have electric wires in the large cities go underground, were heard in this country, it will be remembered the telephone people with one accord admitted that it would be quite feasible for the telegraph and electric light people to operate their wires underground, but claimed that for them to attempt to operate their circuits thus, meant irretrievable ruin. Equally convinced also were the telegraph people, that while it would be very easy for the electric light companies to work their circuits underground, it was quite out of the question that telegraph wires could be operated successfully in subways, since the increased electro-static and electro-magnetic effects would completely destroy quadruplex and fast automatic telegraphy. And no less emphatic was the opinion of the high tension electric light people that the telegraph, the telephone and the low tension electric light systems could, if required, all go underground without detriment, but it was utterly impossible for them to do so, and at the same time to operate their circuits successfully.

New York city was no exception when the time came to place the wires underground. Gradually, however, the telephone yielded—more gradually the telegraph, but more tenaciously the majority of the high tension people clung to their statements, and the experiences of the cities of Chicago, Philadelphia, especially Philadelphia, and elsewhere were cited as evidence of the futility of any attempt to operate high tension currents underground. These experiences were held to show that no insulation could be procured which would withstand the pressure of the high electromotive force employed on high tension circuits. In addition to this it was also asserted that the requirements of the Subway company regarding the insulation resistance of the underground conductors was high beyond all precedent and unobtainable in practice, and that even if such insulation could be obtained it would be impracticable to make tests of the conductors showing them to possess the insulation resistance required by the rules.

It is very far from my intention to go into a history of the opposition offered by the different electrical companies to placing their wires underground and in so far as I have just alluded to it I have done so for the purpose of quoting in a general way some of the reasons given by the companies for this opposition and this only that we may see how far the surmises of those who were thus averse to placing wires underground have been verified by actual results.

It is told of a certain noted geologist that when a specimen of gold quartz, which had been found in a locality where he had stated no gold would ever be found, was shown him, he remarked that if it really had been found there, nevertheless it had no right to be there.

I can imagine that there are many persons—perhaps not in this room—but somewhere, who, if told that telephone, telegraph, high and low tension electric light circuits, and even the "deadly" alternating circuits are to-night in this city working successfully underground in the same streets and on the same side of the streets would reply, "If they really are working successfully there they have no right to be."

In preparing this paper I have found that the subject has almost naturally arranged itself under the following general headings, namely: The type of conduits used in the subways; the drawing in of cables; the methods of distribution; the cables employed in the subways; present condition and probable duration of cables; joints; lead covered cables; insulation and tests; alleged dangers of the subways; gas in the subways; general remarks.

I have been unable to obtain with any degree of accuracy the extent of electrical subways or the amount of wire placed in them in the cities of Europe, and, therefore, I cannot say definitely how New York to-day compares with such cities as London, Paris and Berlin in that respect. But I incline to the belief that it may be found that New York will fall but little if at all behind those cities. In New York city to-day, there are 73 miles of electrical subways and 1,017 miles of ducts. In these ducts there are 10,906 miles of telephone wire, 945 miles of telegraph wire including fire alarm telegraph wires, and 457 miles electric light wires. These subways have a capacity for about 45,000 miles of telephone and telegraph wires and 2,000 miles of electric light wires.

[1]Read before the American Institute of Electrical Engineers, New York, Feb. 18, 1890.

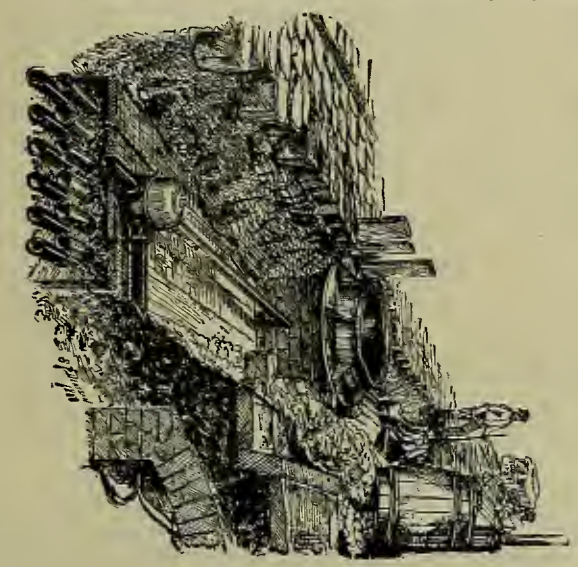


FIG. 1.

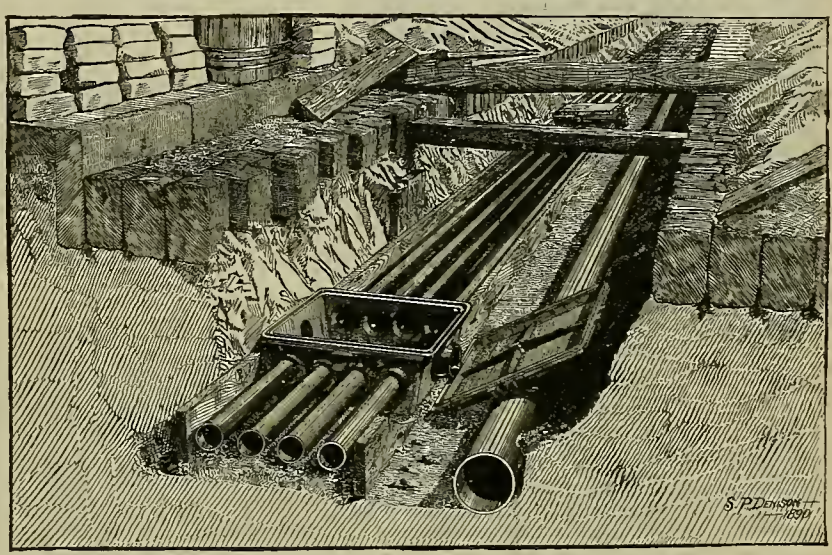


FIG. 5.

PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS OF NEW YORK.

CONDUITS.

There are in the New York electrical subways eight different conduit systems, namely, the Dorsett, the Wyckoff, zinc tubing in hydraulic cement, sheet iron cement lined pipe, wrought iron pipe in hydraulic cement, wrought iron in asphaltic concrete, the Edison iron tube and the Johnstone sectional cast iron conduits. All of these conduits have been frequently described; I shall therefore just briefly refer to each.

The Dorsett system consists of blocks formed of a material, the ingredients of which are pitch, coal tar and fine gravel. The blocks are moulded, with tubular openings about 2½ inches in diameter, from end to end. The blocks are about four feet long and one foot across. The blocks are placed end to end in the trench and are joined together by pouring between the ends a liquid compound of pitch and tar which speedily hardens. This compound is prevented from entering the ducts by sleeves which are placed in each duct between the junction of every two blocks. There is about one mile of this conduit, containing 16 miles of ducts on Sixth avenue. It is used for telephone and telegraph conductors. This conduit was laid three years ago. So far as I can learn it is in a fair state of preservation to-day—but not perfect, the blocks having in some instances sunk and thus put the ducts out of alignment. It may be noted here that guide ropes consisting of one-quarter inch tarred hemp, which were laid in these ducts when this system was constructed, to be in readiness when cables were to be drawn in, show plainly in numerous places, signs of deterioration said to be the result of dry rot combined with the gases found in the ducts.

The zinc tube conduits are laid in Fifty-eighth street The zinc tubing was intended to serve simply as a mould around which hydraulic cement concrete was to be placed, with the expectation that when the zinc had corroded, the tube formed by the solid cement would remain intact. About one mile of this conduit has been in successful operation for three years, but the difficulty attending the construction of a conduit formed in this way was so great, owing to the frailty of the zinc tube, which readily gave way under moderate pressure, that its use has not been further extended.

The sheet iron cement lined pipe conduits are made in single or multiple tubes of 2, 4, 6 or more ducts, as may be required, and in lengths of eight feet. The tubes are connected together by a ball and socket joint. These conduits are made as follows: A sheet iron tube eight feet in length is held vertically; inside of the tube is placed a smaller brass tube, semi-liquid cement is poured into the annular space between the brass and sheet iron tubes. When the cement has solidified the brass tube is withdrawn. The cement tube is then ready for the subways. There are about 113 miles of ducts of this conduit in the subways, and during the coming summer it is expected many times this amount will be laid in New York city.

There are about fifteen miles of creosoted wooden ducts in the subways, known as the Wyckoff conduits. These ducts are formed of wooden piping similar to ordinary pump logs. There are lead covered telephone cables in these ducts and the action of the creosote upon the lead covering is being carefully watched. These ducts have been in operation for three years. I am informed that detrimental effects are noticeable in the lead covering of the cables, which is alloyed with 3 per cent. of tin.

The bulk of the subway conduits consists of wrought iron pipe laid in hydraulic cement concrete. These pipes are twenty feet in length and vary in diameter from two to three inches, Fig. 1. The thickness of the iron is .217 inch. In laying all of these pipe conduits the bottom of the trench is first leveled to grade; planks are then set against the side of the trench to sustain it. A layer of concrete is then laid and rammed in the bottom of the trench. On this is placed a row of iron pipe—next a layer of concrete—then another row of pipe, and so on, until the desired number of layers is attained. The number of pipes in a row depends upon the topography of the street and the location of existing gas and water pipes which it is desired to avoid, and the number of rows upon the total number of pipes desired to be laid in a given subway. In order to add strength to the mass and to protect the ducts from mechanical injury, the concrete is applied more thickly on the bottom, top and sides of the subway than between the pipes. There is placed over all a two inch yellow pine planking, heavily creosoted, to further protect the conduits against injury, from picks, crowbars, etc., in the event of future excavations in the streets.

The wrought iron pipes are joined end to end by a coupling screw joint with a tapering or vanishing thread. By the use of this form of thread, I am informed the rate of laying this piping is increased 50 per cent. These tubes are delivered free from burrs and have a smooth inner surface. The pipes are sometimes asphalted to prevent rusting, but should they in course of time rust, it is expected, as in the case of the zinc tube, that the concrete will preserve the shape of the duct intact. There are close upon 550 miles of wrought iron piping in the subways.

The facility with which a pipe conduit conforms to the varying condition of the crowded streets of large cities, as found in the process of trenching, is one of its chief advantages.

The main reasons which have led to the extensive use of wrought iron piping in the subways are its great strength, its adaptability to varying conditions of the street and the rapidity with which it can be laid.

The Edison system consists of wrought iron pipe in which are placed the copper conductors or rods. These conductors are wound with rope and the pipe is filled with an insulating compound of Trinidad asphaltum, resin, paraffine and linseed oil. These iron pipes are laid directly in the earth. There are about fifty miles of this pipe now laid in New York city.

The subways are in many cases on both sides of a street, and as a rule the telegraph and telephone wires are assigned to ducts on one side of the street and the electric light wires to ducts on the opposite side, but in numerous instances the electric light wires are operated in distributing ducts on the same side of the street as the telegraph and telephone wires, and without detriment to the latter.

MANHOLES.

Access is had to the conduits of the New York subways by means of manholes, placed at an average distance of

about one-twenty-fifth of a mile apart. The manholes are, with a few exceptions built of brick laid in concrete cement, with hydraulic concrete bottom. The outside of the walls is coated with cement to prevent moisture and gas from penetrating.

Access to the manholes from the street is had through the cast iron head which is set on the brick work and which is provided with double covers. The upper or street cover weighs about 350 pounds; the lower cover is provided with a rubber gasket to prevent ingress of street water into the manhole. This cover is funnel shaped in order that any water which may enter through the upper

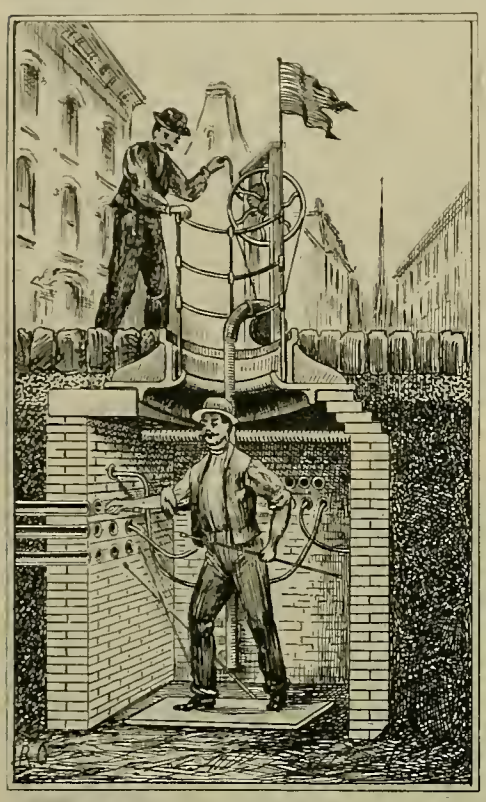


FIG. 2.—PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS OF NEW YORK.

cover may be drained away from the gasket. The lower cover is screwed down upon the gasket by a gun metal bolt and cross bar. The upper cover is loose upon its bearings. The ducts enter the manholes at a point easily accessible to the workmen while standing on the bottom of the manhole. The average width of the manholes is about five feet and varies from five to ten feet in depth. Fig. 2 shows a standard manhole of the New York subways. The hand blower used for driving out gas from the manholes is shown, also the iron framework or cage which is placed around the opening to the manholes when the cover is removed. The foregoing mentioned conduits may be considered as belonging to the regular subway system of New York city.

There are however, several other conduits in operation in this city, namely, the Brooks, the Western Union and about five miles of telephone cable laid in wooden boxes filled with sand. The Brooks system has been so repeatedly described I need not further allude to it. The Western Union subway consists of an iron pipe about six inches in diameter into which wires have been drawn.

RODDING.

The electrical subways of New York city with the exception of the Edison system, are of the class known as the drawing in and out systems. The first process in drawing a cable through a duct which is not easily accessible except at its ends in the manholes, is obviously to provide a means of drawing in the cable. This is done by a process technically termed "rodding," which consists of pushing rods through the duct from one manhole to the next. A rope is then attached to the end of the rod and the rod is withdrawn bringing the rope with it. This rope is then employed to haul in the cable. As some of the manholes are over 500 feet apart and it would not be convenient to procure a continuous wooden rod of that length—rods of about four feet in length furnished at one end with a screw and at the other end with a screw socket, are used. These are placed in a bunch in the manhole and are attached by the screws one to the other, as many as are required to reach to the distant end of the duct. The rods are then detached as they are drawn out by unscrewing the ends. The time taken in rodding a duct of 300 feet in length is about twenty minutes.

Continuous steel wire rods about one-quarter of an inch thick and from 300 to 500 feet long are also used for rodding the ducts. These rods are mounted on a reel about six feet in diameter, which is placed adjacent to a manhole and from which it is reeled off as the rod is pushed through the duct. When this operates freely, it is more expeditious than the wooden rod methods just described, as the time taken in jointing up the rods is saved, but it is found that the wire occasionally buckles on the duct and furthermore it is more apt to be caught by any obstruction or unevenness than are the wooden rods, so that by many the latter are employed as being the more expeditious, all things considered.

There is also another method of rodding sometimes employed, which consists of a long spiral steel rod, the spiral of which is about one inch in diameter. On the circumference of the spiral small wheels are mounted, to ease the friction. This rod is also placed on a reel and wound off as it is fed into the duct. This spiral while quite elastic is yet capable of withstanding considerable pressure. This rod is pushed into the duct in the usual way. The expense and the weight of this form of "rodder" is somewhat against it, although I am informed that by its use a duct can be rodded in one half the time required by the screw rods.

Before those employed in the work of drawing in conductors into subways had devised and settled down to the forms of rods just described, many bright minds were at work on the question of how to rod the ducts. The scheme of tying a string to a rat's tail and sending him through the duct with a ferret after him was tested practically in Brooklyn, I believe, but the plan was not generally adopted. In the case cited, it is stated that the ferret overtook the rat and stopping to eat him was overcome by the gas and asphyxiated. This necessitated tearing up of the street to get at the remains.

In Chicago it was seriously suggested that a wooden ball with a string attached to it, be placed in the duct and that then a hose connecting with a neighboring hydrant be inserted in the duct. The water was to force the ball through the duct. This plan was found to work successfully, so far as getting the ball through was concerned, but it flooded the manholes, and was not put into general use, even in Chicago.

Another inventor devised what he called a mechanical creeper which was designed to advance itself through the ducts by putting out arms against the walls, and thus pushing itself along.

Sometimes in rodding, obstructions are met with caused by pieces of cement, stone, dirt, etc., gaining access to the ducts. Sometimes also obstructions are caused by uneven joints in the conduits. Ordinary obstructions are removed by a mandrel placed on the first rod.

DRAWING IN CABLES.

After the rope has been attached to the cable, the latter is then "threaded" through the duct. The attaching of the rope to a cable is a matter of some skill. The connection is so made that the strain comes chiefly in the conductors. To prevent the cable or cables from twisting as drawn in, a swivel is inserted in the rope near the cable.

The manner of applying the force necessary to pull the cable through the duct depends upon the size and length of the cable. If it is a small cable, say 300 feet in length, it can be drawn in by two or three men. If it is a large cable, or if four or six small cables are to be drawn into one duct as is frequently done, more elaborate drawing-in apparatus is used. This generally consists of some form of winch such as is shown in Fig. 3 which very well illustrates the method. The largest telephone cables are drawn in by a winch of special construction in which the power is transmitted through the intervention of wheel gearing. As a rule it may be said that in the matter of drawing cables into the ducts the work has been satisfactorily performed. In a few instances mistakes have been made as in the attempt to draw too many cables into one duct—the old problem of putting a 3-inch bung into a 2-inch hole,—and in the attempt several lengths of cable have been jammed in the ducts and injured. As many as six electric light cables, No. 4 B & S conductors have been repeatedly drawn at once into a 3-inch duct. It is not deemed advisable to draw cables into or out of ducts over cables already laid, but in cases of necessity it has been done without injury to the cables.

As the weight of a No. 4, B & S lead covered cable is for 300 feet, say 250 pounds, an idea may be obtained of the force required to draw in six such cables. I am informed that cables weighing in the aggregate 5,500 lbs., have been drawn at one time into one duct.

METHODS OF DISTRIBUTION.

It is, of course, a comparatively easy problem to arrange an electrical subway for trunk line circuits. The difficulty arises when the question of distribution of the current from the main conduits is to be considered, as when, in the case of the telegraph and telephone service, it is desired to furnish city customers with circuits; and in the case of electric light service when it is required to make house to house or street lamp connections.

In the case of telegraph and telephone distribution subsidiary pipes or ducts are generally led from an adjacent manhole to the front or side of buildings, whence the cables are continued to the roof of the building or to the back yards, from which latter points the circuits are radiated as required.

The cable of the telephone company is generally made up into fifty pairs. When this number of circuits is not required in one block or series of blocks, the cable is forked in the manhole, one portion of the conductors being led in a smaller cable in one direction, another portion elsewhere as may be required. This method of distribution has been found convenient and satisfactory.

Distribution of the electric light current is effected in several different ways in the New York subways. For street arc lamps the circuit is usually looped from the manhole to the lamp post through a subsidiary iron pipe.

For easy access to houses and to lamps in the middle of blocks distributing ducts are laid above the trunk ducts as near the surface of the street as practicable, the average distance from the surface of the street being perhaps eighteen inches.

The Johnstone sectional conduit, Fig. 4, has hitherto been the most extensively employed for this purpose in New York city. This conduit consists of sections of cast iron ducts about five feet in length. The sections are placed directly above each other and are held together when in position by removable clamp pins. The upper section rests in a groove in the lower section. Each section of the conduit is divided into two, six or more compartments or ducts,—depending upon the size of the section—the ducts being formed by removable partitions or slats held in position by suitable channels or grooves within the sections. Opposite each house or every alternate house a handhole is provided in the upper section of the conduit. This handhole consists of a removable cover, about two feet in length, on the upper section, and the side of the section at this point is provided with a branch or spigot.

This conduit is laid directly in the earth, not in cement. When it is desired to obtain access to a conductor to tap or loop the circuit into a building, the paving and earth are removed from the street and the cover of the handhole is lifted, thus exposing the conductors in the ducts. A 3-inch iron pipe is run from the branch at the handhole to the basement or vault of the house or to the lamp post with which connection is desired to be made. This iron pipe fits on to the spigot at the side of the conduit. The connection is then made with the conductors by splicing on short lengths of cable leading through the iron pipe to the house or lamp. Should the conductor which it is desired to tap be at the side of the section remote from the spigot, the intermediate partitions are removed to permit the passage cross-wise of the connecting cable. After the joints are made the cover of the handhole is replaced, and the earth and paving are restored to their normal condition.

When a handhole has not been provided originally at a point where access is desired to a conductor in the conduit, the entire upper section is removed and replaced by a half section containing a handhole cover and spigot. This work can be done in a short time. The sections in use for this purpose are in some instances somewhat small for ease in joint-making, especially, as but very little slack is available when T joints are to be made, and, in future, larger handholes will be provided. These conduits are presumably made air and water tight at the junction of the two sections and, and at the ends of the ducts, by the use of plumber's putty. In view of the number of supposed opportunities for the entrance of moisture at these junctions it would be naturally expected that this type of conduit would be in a chronic moist condition Indeed, it has been predicted of it that the ducts would act as canals for the surface water,—but, as a matter of fact, these ducts are almost invariably dry. There are two theories given to explain this fact. The first, that in reality the plumber's putty makes an air and water tight joint. The second, that if the joints are so imperfect as to admit water, they are quite capable of permitting its escape also. It must be said that this system has been found of much utility in the practical distribution of electric light current in this city.

More recently a method of distribution in which wrought iron pipes are used has been employed. Fig. 5. This consists of a row of three or four iron pipes laid, like the Johnstone conduit, as near the surface as possible,—in the earth without concrete. Opposite every party wall or, in other words, at distances of about fifty feet apart, iron boxes about eighteen inches square are placed. Then these boxes have removable covers. The ducts enter at the ends of the box but do not pass through it. The boxes are provided with side openings also for the entrance of the subsidiary iron

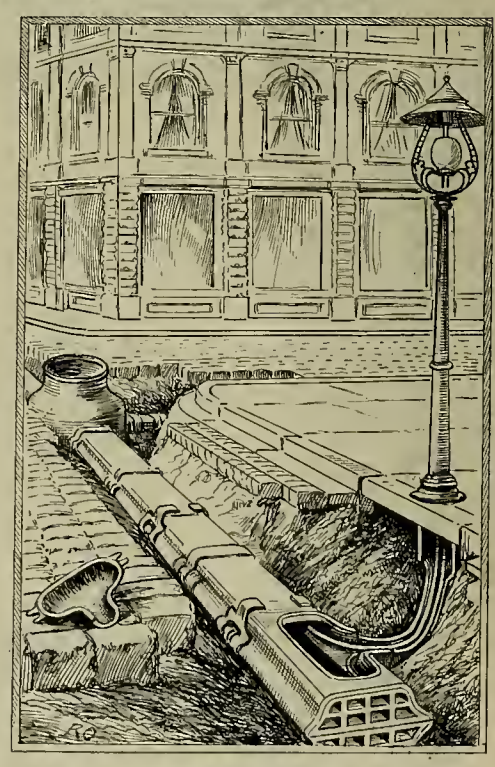


FIG. 4.—PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS OF NEW YORK.

pipes. Access is had to these boxes, also, by the removal of the street paving and earth.

This method of distribution has, like the one just described, been found satisfactory. Certain mechanical improvements in the construction of both are however desirable and are contemplated.

When it is desired to cross a street to reach customers subsidiary ducts are constructed.

It is frequently remarked, presumably derogatory of the

existing electrical subways, that no system of house-to-house distribution can be considered perfect which requires the tearing up of any portion of the street to obtain access to the mains. This will be granted by any one. The same is equally true of the house-to-house distribution of gas and water from the street mains. In all of these cases if the connections were made from the street mains to every house and vacant lot along their routes when the mains are first laid the necessity for reopening the streets to make house connections would be avoided. But I have yet to learn that this is done by either the gas or water companies, nor have I heard that their neglect to do so has been seriously animadverted upon.

It would, therefore, seem unreasonable that the additional expense of making these connections, which may never be required, should be urged upon the users of the subways by any who have the interests of electrical industries at heart, especially while they ignore the failure of the gas and water companies to make corresponding connections.

CABLES AND INSULATION USED IN THE SUBWAYS.

In the telephone service in this city, the cables used are chiefly of the type known as the Patterson. The insulation of this cable is constructed as follows: Ordinary cotton covering is first placed around the wires. After the wires are cabled a lead covering is placed over them and paraffine is then forced into the interstices between the conductors and lead covering.

This cable has a electrostatic capacity of about .16 microfarad. The insulation resistance of the cable, laid and jointed in the subways, averages about 100 megohms. The longest stretch of cable, used by the telephone company, in the subways is seven miles. The greatest number of conductors in any one cable is 100 or 50 pairs.

The telephone service on the underground conduits was impaired somewhat, so long as ground circuits were used, but since the adoption of metallic circuits the service is satisfactory. On the long distance telephone circuits, the seven miles of cable is of course somewhat detrimental. It is said the loss of efficiency on such circuits is 30%.

The telegraph companies have thus far used chiefly for underground service, kerite, okonite, Standard underground and Patterson cables. The kerite and okonite insulation, it is well known, are homogeneous compounds. These cables are not lead covered. Of course they could be. The Standard and Patterson are fibrous cables and are lead covered.

Except in the vicinity of the underground steam pipes, the unprotected homogeneous cables have given uniform satisfaction. But as might be expected, the effect of escaping steam upon them has been detrimental.

Fortunately the heated area in the vicinity of the electrical subways is limited to a portion of the down town districts. Investigation has shown that the heat only reaches a harmful temperature in the neighborhood of actual leaks in the steam pipes. Measurements of the temperature of a manhole in the worst section of the heated district have shown as high as 150° to 200° F. Since the starting of the blowers on this district, to ventilate the subways, a noticeable decrease in the temperature is observable, and inasmuch as the steam heating company is achieving some success in its efforts to close up all leaks in the pipes, it is anticipated that the heat difficulty will be eventually removed from the subways.

The users of the Standard and Patterson cables state that those cables are giving very fair service in the heated portions of the subways, although the high temperature of course lowers the insulation resistance of the cables.

The average number of conductors in the telegraph underground cables is about fifty. The size of the wire used is, as a rule, No. 16, B. W. G. and the outside diameter of a conductor including the insulation is $\frac{5}{32}$. The insulation resistance of the okonite insulation is about 2,500 megohms; that of kerite 500 to 800 megohms, and that of the Standard and Patterson, about 1,500 megohms per mile for the thickness of insulation just mentioned.

Outside of the injury to the cables due to the presence of the steam heating pipes, no undue deterioration of the telegraph cables in the subways has been noted.

The effect of the increased electro static capacity of the underground circuits has not caused any marked inconvenience in the operation of the telegraph circuits.

The comparatively low mileage of telegraph wire in the subways is partly explained by the fact that the bulk of the telegraph circuits in New York city are suspended from the elevated railroad structures. The fire alarm telegraph cables in the subways do not differ very materially from those used by other telegraph companies. The fire department thus far has used Standard underground cables.

St. Louis Electrical Exposition.

The second annual electrical exhibition will be held in St. Louis from September 3d to October 18th. The exhibition last fall was entirely successful. The number of visitors was over 13,000 daily. It is confidently expected that the coming exhibition will be even more successful. No charge is made to exhibitors for floor space or for steam or electric current required for machinery. All articles exhibited are returned without charge to the exhibitor for freight. Gold, silver and bronze medals and diplomas are to be awarded for the best arc and incandescent systems, the best dynamos, motors, storage batteries, electrical instruments, wires and cables, and electrical apparatus generally. A special award will also be made for the best electrical display, and for the most meritorious electrical invention patented since October 19, 1889.

The awards will be made by a committee of three gentlemen, one of whom the National Electric Light association has named; one of whom the American Institute of Electrical Engineers appointed at the recent convention; and the third will be voted for by the electrical fraternity generally. Fred H. Whipple of Detroit, Mich., will be general manager of the exhibition.

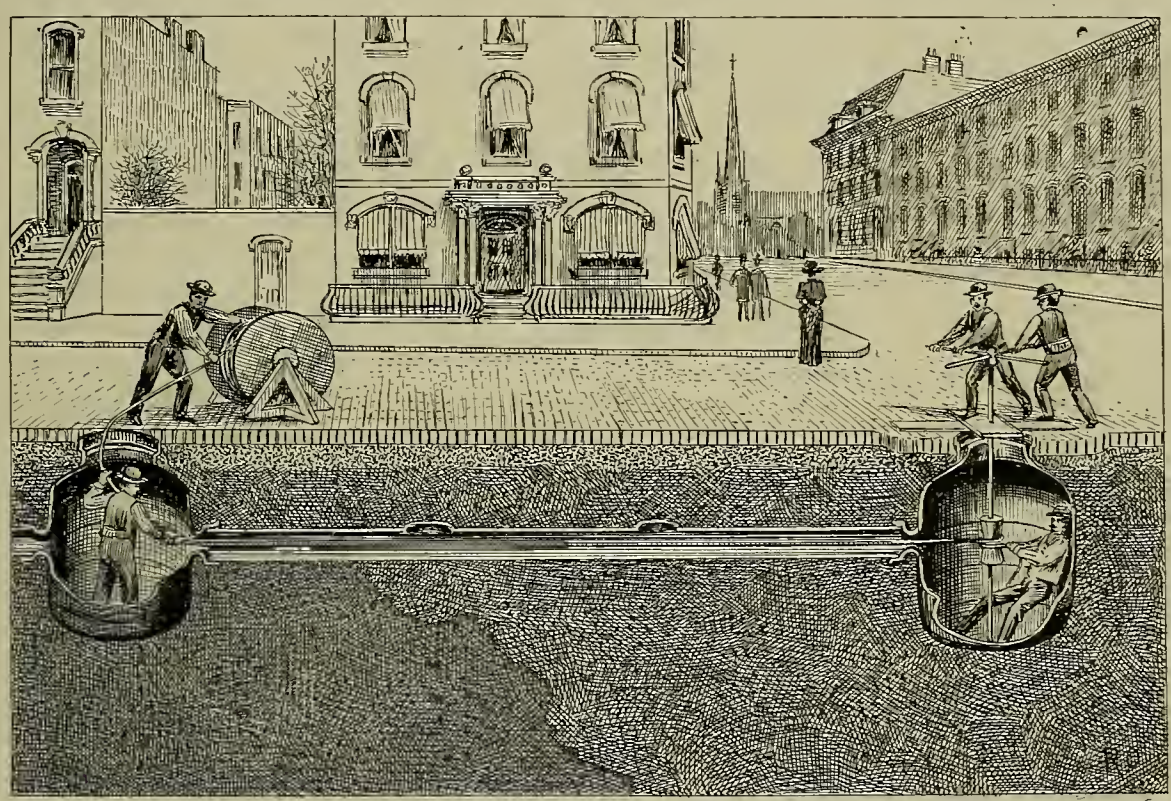


FIG. 3.—PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS OF NEW YORK.

Electric Railways in Milwaukee.

It is expected that a complete electric railway system will be in operation in Milwaukee at an early day. Already an excellent start has been secured by the equipment of two important lines, and it is hoped that the others will soon be induced to follow this example. Milwaukee has long needed rapid transit and its residents have agitated the subject, but to no purpose, until the present movement was made for electric roads. The West Side Railroad company and the Hinsey lines will be equipped with electrical apparatus. The work is now well under way, but the companies, despite their efforts to introduce an improvement, have met with considerable opposition where they might have reasonably hoped for assistance. Complaints have been circulated and petty grievances have been aired through the Milwaukee newspapers and dispatches have been sent to papers in other cities creating an erroneous impression of the work of the companies in Milwaukee. It has been asserted that the electrical machinery had been condemned, and that the controversy between the city authorities and the street car companies threatened to tie up the lines permanently. In relation to this matter, John A. Hinsey made the following statement for the WESTERN ELECTRICIAN: "There has been no controversy between the authorities of this city and the street railway companies as to electrical machinery. The only question in dispute was the height and strength of poles which had been erected. In granting the electric railway franchise the Board of Public Works was invested with power to act for the city when it considered any portion of the construction of the road unsafe or improper, and as it decided that the poles erected were not of sufficient height and strength for public safety, the electric railway company is compelled to replace them with poles which will meet these requirements."

Thomas J. Durnin, secretary of the West Side Railroad company, gave the following statement of the condition of that corporation's lines: "Our poles are 6", 5" and 4"; each section is telescoped into the other for 18 inches and stirruped, and all standard wrought pipe. The same style of pole is now in use in Cleveland and elsewhere, but they are not strong enough to take the strain of the curves without considerable deflection. Consequently we used guys, just as all electrical companies do. It was not a question of safety, but it was offensive to the taste of the citizens in front of whose property the guy poles were set. The city authorities ordered stronger poles put in that would singly take the strain. Rather than have any trouble the Sprague company, which is putting in our plant, ordered and put in for curves poles made from 7 pound angle iron, four sections latticed, 13½ inches at the bottom and 6½ inches at the top."

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PUBLICATION OFFICES:

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 125 TEMPLE COURT, NEW YORK.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE last number of the WESTERN ELECTRICIAN containing a stenographic report of the Kansas City convention of the National Electric Light association, reached its subscribers so soon after the close of that meeting that the fact occasioned no little surprise. Forty pages were devoted to a report of the proceedings. The association adjourned Friday afternoon. On the following Monday the WESTERN ELECTRICIAN was mailed so that it reached its readers even in the East a full day before they could have obtained an eastern journal containing a complete report of the proceedings. Inasmuch as the enterprise of the WESTERN ELECTRICIAN has caused considerable comment, a brief reference to the work involved in the publication of the last issue may not be without interest. According to a rough estimate, the report comprised double the amount of reading matter contained in an average daily issue of a metropolitan daily like the New York *Sun*, and twice that printed in a volume like "John Marshall" of the "Statemen's Series." The proceedings were reported by three stenographers whose notes were transcribed by as many typewriters. The copy was edited in Kansas City and mailed to Chicago where compositors were kept at work day and night putting it in type. An immense amount of matter, as much as that contained in an average novel, reached Chicago the day following the convention and was handled with such dispatch that five presses were started at an early hour Monday printing the entire proceedings. A reference to the portrait of Marsden J. Perry, the new president of the National Electric Light association, which appeared on the first page of the last issue, may not be out of place. The photograph from which the cut was made was taken in Kansas City Friday afternoon. On the following afternoon the cut was finished and the block was ready for the form.

THE announcement that the street railway companies of St. Louis now operating with horses will petition the municipal assembly to change to electricity, may be considered an important victory for the electric motor. It will be remembered that the companies at first decided to introduce cables, but the people objected. They had witnessed the operation of the electric roads and found them successful, while it was equally apparent that the cable road had not given satisfaction in many instances. In a word, the patrons of the roads expressed a preference for an electric system and the municipal council can only grant the petition if it has the interest of the city at heart, and considers the wishes of the people.

IN the last number of the *Atlantic Monthly* Dr. Oliver Wendell Holmes in "Over the Tea-cup" ridicules very effectively Bellamy's "Looking Backward." In the course of Dr. Holmes' sketch one of the characters relates a dream of a journey through space. In speaking of the moon the dreamer makes this very pretty reference to the incandescent lamp. "The Lunites do not breathe; they live without waste and without supply. You look as if you do not understand this. Yet your people have as you well know, what they call incandescent lights everywhere. You would have said there can be no lamp without oil or gas or other combustible substance to feed it; and yet you see a filament which sheds a light like that of noon all around it, and does not waste at all. So the Lunites live by influx of divine energy, just as the incandescent lamp glows—glows, and is not consumed; receiving its life, if we may call it so, from the central power, which wears the unpleasing name of dynamo." The most enthusiastic admirer of the incandescent lamp would not ask for a happier reference to its light than that of "a filament which sheds a light like that of noon."

BEGINNING with the discovery of Sir Humphrey Davy in 1810, the development of arc lighting was traced through its experimental stages to its present commercially successful basis by E. F. Peck in his paper on "Carbon Tests," which was read at the Kansas City convention of the National Electric Light association. The fact that little attention was given to many important features, and that no records were kept showing the life, resistance, etc., of the carbons in the early days of arc lighting, was explained by the satisfaction which the manufacturers evidently felt when they were able to produce carbons that would burn, no matter how unsatisfactory the light might be. As soon, however, as it became apparent that there would be a demand for commercial arc lighting, there was keen competition, and the cost of carbons was materially reduced while the quality was greatly improved. Mr. Peck gave the result of tests which he had made, though, however, for obvious reasons the names of the manufacturers were not presented, and he advised superintendents of arc light stations to follow his example and base their purchases on the results of these tests. If this course were generally followed there can be no doubt it would tend to reanimate the competitive qualities of the companies, and even better carbons would be the result.

IN H. W. Pope's paper which was read at the recent convention of the National Electric Light association, the companies that have contributed to arousing public feeling against overhead wires, will find but little consolation. Mr. Pope pointed out the fact that by keeping their lines in proper condition they would remove all cause of complaint, and that the inclination of legislatures and town councils to restrict the rights and privileges of electric companies must receive a check. He said: "It should be the aim and policy of all electric corporations to constantly improve the condition of poles and lines—giving as much attention to their strength and beauty as to their perfection electrically. The assumption that such a course is unwise, because of the theory that sooner or later all wires must be buried, is wrong, because it is questionable whether such an extreme will be reached, especially in cities and towns of small population." He counseled immediate action, and added: "Every day that you delay these improvements you encourage adverse criticism and hasten adverse legislation, state and municipal."

IN this issue is published in full Judge Taft's decision in the celebrated suit of the telephone company of Cincinnati against an electric railway in that city. The action was instituted to enjoin the defendant company from using the single trolley with the rail as a return. This method of operation, by reason of leakage and induction, it was alleged, interfered seriously with the circuits of the telephone company, and rendered many of the lines almost useless. The suit has been watched with the greatest interest by electrical railway and telephone representatives, as it has been regarded as a test case. It will be remembered that Lieut. Frank J. Sprague in his paper presented at the Kansas City convention of the National Electric Light association referred in considerable detail to the "conflicts," to use his word, between the telephone and electric railway interests. As a representative of a motor company he naturally viewed the subject from the electric railway standpoint. It is interesting to compare his opinions as expressed in the paper, with those of Judge Taft, who reaches in his decision a radically different conclusion. In regard to the disturbances on the telephone lines generally, the views of Lieut. Sprague and Judge Taft are identical. The interferences are extremely serious. In reference to induction and leakage Judge Taft says, "speaking in a general way" the disturbance on the lines may be attributed half to leakage and half to induction. Lieut. Sprague's idea is entirely different. He says, "The trouble from induction is of the slightest character, and again, the trouble which really does become pronounced is that which is due to the actual differences of potential which exist on different parts of the track circuit, or in other words, at the terminals of the grounded telephone circuits." Mr. Sprague says telephone companies should put up a metallic return or use the McCluer device for the general good of their service regardless of the operation of electric railways. Judge Taft decided to enjoin the railway company on the ground that the plaintiff was the prior occupant of the streets and the defendant could not exercise its privileges to operate cars if in doing so it encroached upon the former's rights, unless there were a special legislative provision warranting it in its interference. While admitting that the metallic circuit would remove all evils arising from induction and leakage, Judge Taft says the expense would be perhaps greater than the original outlay for the grounded line. The McCluer device, he says, would perhaps remove the trouble from leakage but not that produced by the induction from which he finds that half of the disturbance arises, but which Lieut. Sprague says is of the slightest character. The latter is of the opinion that the McCluer device is extremely effective. The court agrees with Mr. Sprague that the single trolley is used on nine-tenths of the electric railways, but says that the reason is to be found in the fact that this system is cheaper and because it does not involve so many complications. He finds the two-trolley system is perfectly practical and although its use would entail a substantial expenditure he thinks the company should adopt it. Mr. Sprague enumerates a vast number of reasons why the single trolley system is vastly superior and on this point his views are diametrically opposed to those of the court. The defendant will appeal and, as Mr. Sprague says, this will doubtless be a celebrated case.

Decision in the Telephone-Electric Railway Suit at Cincinnati.

Judge Taft's decision in the suit of the City & Suburban Telegraph Association of Cincinnati against the Cincinnati Inclined Plane Electric Railway Company will be found below. The action was instituted to restrain the defendant company from operating its cars by the single trolley system. As the suit has been looked upon as a test case, the decision is of special interest to telephone and electric railway companies. Judge Taft's decision is as follows:

This is an action to enjoin the defendant from using a system of electric railway propulsion known as the single trolley system, in running its cars upon the streets of this city and the roads of the county, because, as plaintiff claims, it does a great injury to the conduct of the public business in which it is engaged, *i. e.*, the maintenance for profit of telephone communication between a large number of subscribers in the city and county. Plaintiff alleges that it has been conducting its business under lawful grants of the legislature of the state and the municipal authorities, and by virtue thereof has lawfully erected many lines of telephone wires on the streets upon which the street railway of defendant is constructed and operated; that the defendant has no lawful authority to use electricity as a propulsive power for its cars; that the single trolley system in use by defendant conducts upon and induces upon the wires of the plaintiff erected on the same streets, currents of electricity, which make it impossible to use those wires for the purpose of telephone communication; that the result is, that many of the subscribers of plaintiff have made complaint and threatened to discontinue the use of the telephone, and some have refused to continue payment for the same, all to the great injury of the plaintiff; that the damage is irreparable and continuous, and that plaintiff notified defendant before the erection of the single trolley system that it would result in a serious injury to plaintiff, and of the objection to the system.

The defendant answers, denying plaintiff's lawful right to operate telephone lines; avers its own lawful right to conduct a system of electrical railway propulsion, avers that the single trolley system is the only practicable one in use, and secures advantages to the defendant not afforded by any other; that plaintiff's difficulties arise from the defects of its own telephone system, in that, for economy, it uses the earth as a return conductor, and so invites onto its lines many disturbing currents, both natural and artificial, although the mechanism of the telephone is so delicate that any proper system would make the return circuit metallic; that plaintiff's claim amounts to a claim to the exclusive use of the earth as a conductor, which is without warrant of law; that the use by the defendant of the earth as a return circuit is a material assistance in propelling cars up heavy grades; that it could not alter its system so as to avoid the use of the earth as a return circuit, except at great outlay and loss of efficiency. The answer denies that the operation of its road produces interference with the telephone lines of plaintiff, and says that, if any injury has been produced for which defendant is liable, the damages are capable of exact ascertainment, because they can all be remedied by an additional expenditure by the plaintiff, and that therefore there is no ground for equitable relief.

Plaintiff, by its reply, denies the allegations of the answer.

First. The plaintiff company was organized in 1873 as a magnetic telegraph company, to conduct a telegraph business on lines within the city and between here and Hamilton, under laws which have since been incorporated in Chapter 4, Title II, concerning magnetic telegraph companies. Section 3454 provides that "a magnetic telegraph company heretofore or hereafter created may construct telegraph lines from point to point, along and upon any public road, by the erection of the necessary fixtures, including posts, piers, and abutments necessary for the wires; but the same shall not incommode the public in the use of such road." Section 3461 provides that, "when any lands authorized to be appropriated to the use of a company are subject to the easement of a street, alley, public way, or other public use, within the limits of any city or village, the mode of use shall be such as shall be agreed upon between the municipal authorities of the city or village and the company; and if they can not agree, or the municipal authorities unreasonably delay to enter into any agreement, the probate court of the county, in a proceeding instituted for the purpose, shall direct in what mode such telegraph line shall be constructed along such street, alley, or public way, so as not to incommode the public in the use of the same; but nothing in this section shall be so construed as to authorize any municipal corporation to demand or receive any compensation for the use of a street, alley, or public way, beyond what may be necessary to restore the pavement to its former state of usefulness."

In 1878, the telephone, as a practicable commercial instrument, came into use, and the plaintiff became the licensee of the American Bell Telephone company, with exclusive right to use all its patents in this city and county. Before this time, in 1873, the common council had passed resolutions fixing the terms under which the plaintiff might occupy the streets with its poles. From 1878 until the present time, the business of the plaintiff has grown to such an extent that it now has over 3,000 subscribers in the city and vicinity. The pole lines of the plaintiff along the streets occupied by the defendant's railway were erected in 1881 and 1882. In 1880, the following section was added to the telegraph law, 3471: "The provisions of this chapter shall apply also to any company organized to construct any line or lines of telephone; and every such company shall have the same powers, and be subject to the same restrictions, as are herein prescribed for magnetic telegraph companies."

The pole lines of the plaintiff are so erected under the ordinances of the city as to leave a bar at the top of each pole on which to string the wires of the fire department telephone lines. The fire department and police department are each given a separate exchange, operated by city employes. The city strings its own wires upon the telephone poles, but pays nothing to the plaintiff for the use of the instruments, or for the general exchange work of the fire and police departments. The poles have been erected at such places as directed by the engineer of the Board of Public Affairs, and under his supervision. The plaintiff has always used the earth as the return circuit. This has been the case with all the telephone systems in this country down to the present day, with the exception of certain long distance lines from New York city, and the connecting subscribers who frequently use those lines in that city. The telegraph companies used and still use the earth as the return for the circuit. The most complicated part of the telephone business is the mechanism by which temporary connection is made between any two subscribers' lines. It is called a switch-board, and each one of the exchanges, of which there are five in this city, is furnished with one. It is a very expensive instrument, and could not be adapted to use for a system of metallic circuits.

It will thus be seen that every step taken by the plaintiff was authorized by law, and that all that has been done by it has been with the consent of the proper authorities. From this statement, there can be no doubt that the plaintiff has a lawful right to occupy the streets upon which defendant's track is laid, with the poles and wires erected for the conduct of its business, and that the use of the earth as a return is not a violation of its franchise. It was organized and still is called a telegraph company. It began its telephone business before section 3471 was passed, and perhaps some of its poles and lines along the streets occupied by defendant were erected for such use. But this circumstance is immaterial, for it has been held, both in England and in this country, that the telephone system, which is communication over long and short distances through the agency of currents of electricity on metal wires, is really a magnetic telegraph system, and that an exclusive right to operate the telegraph includes the exclusive right to operate telephone lines. (Attorney-General v. Edison Telephone company, 6 Q. B. D. 244. Wisconsin Telephone company v. Oshkosh, 62 Wis. 32.)

Nor does the passage of section 3471, which expressly makes the chapter on magnetic telegraph companies applicable to telephone companies, affect this conclusion. It was passed simply to remove the basis for an argument, and not because the chapter was not already sufficient to include telephone companies without it. (Chesapeake, etc., Telephone company v. B. & O. Telephone company, 66 Md. 399.)

But, even if it were true that, when the plaintiff company, in 1878, began to use the telephone system, it was beyond its charter, it seems to me that the subsequent legislation of 1880 would have validated what before was *ultra vires*. (See Spring Grove Avenue Railway company v. Cumminsville, 14 Ohio St. 523.)

I have not discussed, in this connection, the question how much the abutting property owners' rights were affected by the erection of the poles and wires of the plaintiff, because their rights are not in issue, and it is to be presumed, from the fact of plaintiff's occupation for so many years, in the absence of other evidence, that if any of the rights of the property owners were taken, they were ceded or sold to the plaintiff.

Having determined, then, that plaintiff's use of the streets, on which defendant operates its road, is lawful, the next question which arises is, whether defendant has the right to use electricity for the propulsion of its cars. If it has not, and it thereby interferes with plaintiff's franchise, it is very clear that such interference gives plaintiff a right of action. Defendant's counsel seems to contend that the question of *ultra vires* cannot be raised against the defendant in this case; but that such an issue could only be made in an action by the state, or its delegated representatives, to oust the defendant from the exercise of such unwarranted privilege. This contention can not be sustained, for while it is true that if defendant is violating the limitations of its charter, plaintiff might request the attorney-general to institute *quo warranto* proceedings, nevertheless, it may rely on the fact of defendant's violation of its charter in a private litigation to show that the acts causing loss are unlawful. (City of Zanesville v. Zanesville Gaslight company, Supreme Court of Ohio, 23 W. L. B. 8.)

The larger portion of the line now occupied by the defendant, was once operated by the Mt. Auburn Street Railroad company, under a number of grants from the common council, the first of which was made September 2, 1864, and the last, November 14, 1873. All these grants were subject to the provisions of the general street railroad ordinance of 1859, that no motive power except horses and mules should be used on any road without the consent of common council. The franchise and property of the Mt. Auburn Railway company was purchased by three persons: George A. Smith, J. M. Doherty and Jos. S. Hill. On April 21, 1871, the Cincinnati Inclined Plane Railway company was incorporated under the general corporation act passed May 1, 1852, for the purpose of constructing a railroad whose termini should be in Cincinnati and the village of Avondale, and then constructed the inclined plane, still in use, connecting Locust street, Mt. Auburn, with the head of Main street. By ordinance, December, 1871, common council gave the company the power to lay tracks on certain streets which connected it with the Mt. Auburn street railroad tracks, with the express proviso that no motive power except horses and mules should be used on said tracks. A similar proviso was contained in an ordinance passed October 27, 1875, granting it the right to extend the tracks of the Mt. Auburn street railroad tracks to the north corporation line, at the Zoological Garden. In 1876 an act was passed (73 Ohio L. 229), providing for the organization of inclined plane companies, and authorizing them to construct, operate and maintain an inclined plane railroad for the conveyance of passengers and freight, or either, with such offices, depots and other buildings as they may deem necessary; also, to establish and maintain a park or pleasure grounds, and for such purposes to hold real estate. Section 10 of this act, provided that whenever the part of the roadway of such railroad operated by steam power shall cross a public highway, such part of the railroad's railway shall pass either over or under such street or highway, and shall be constructed in such a manner and at such a distance above or below such street or highway as not to obstruct the ordinary uses of such street or highway.

March 30, 1877, the legislature passed a law providing that any inclined plane railway company organized under the General Corporation Act of May, 1852, should have "the power to hold, lease or purchase and maintain and operate such portion of any street railroad leading to or connected with the inclined plane as may be necessary for the convenient dispatch of its business, upon the same terms and conditions on which it holds, maintains and operates its inclined plane. Provided, that no other motive power than animals shall be used on the public highways occupied by such street railway company without the consent of the Board of Public Works in any city having such a board, and the common council, or the public authority or company having charge, or owning any other highway in which such street railroad may be laid: and, provided, that no inclined plane railway or railroad company shall construct any track or tracks in any street or highway without first obtaining the written consent of a majority" of the abutting property holders."

June 19, 1877, George A. Smith, James M. Doherty and Joseph S. Hill leased the Mt. Auburn railroad perpetually to the Cincinnati Inclined Plane Railway company. On September 24, 1885, the Board of Public Works passed a resolution consenting to the use by the defendant either of electricity, cable or compressed air as a motive power "upon the highways in which the street railroads connected with its inclined plane, and held and operated by it are laid," on condition that defendant gave bond in $25,000 to hold the city harmless from any damages to persons or property arising out of the use of such motive power. On October 24, 1888, the Board of Public Affairs gave the defendant permission to erect along the entire length of its road the poles, wires, and appliances necessary to operate and maintain its entire line from Fifth and Walnut streets to the Zoological Garden as an electric road, in accordance with plans and specifications submitted to the Board. The poles and wires were erected under the supervision of the engineer of the board. On February 23d the stockholders of defendant extended its terminus to Glendale, Hamilton county, Ohio, and certified the same to the secretary of state under section 3306 of the General Railroad Chapter and under such extension are now constructing a line of road along the Carthage pike under the consent of the county commissioners, given March 23, 1889, to use and occupy said pike with double tracks and with necessary appendages and appurtenances of an overhead electric street railroad system. This consent contains the provision that the county commissioners are to cause the removal of any or all telegraph or telephone poles which may interfere with the operation of said electric road. The grant thus given was modified in September, 1889, but only with respect to the part of the street to be occupied.

Plaintiff's counsel maintains that on this record of the title of defendant, the present operation of this road is unlawful for several reasons.

First. That the act of 1876 providing for the incorporation of inclined plane railways requires that in passing over streets it should be conducted on bridges or in tunnels, and the act of May, 1877, provides that the operation of the railways to be leased shall be subject to the conditions upon which its inclined plane is operated.

Second. That the road connected with the inclined plane to be leased and operated by it under the act of 1877, was to be a "portion" of some other road, and that here the defendant is operating the entire road, nor is it shown that the road as used is necessary to the convenient dispatch of the business of the inclined plane.

Third. That a proper construction of the first proviso of the act of 1877 requires that the consent necessary to permit the use of animal power shall be given by the Board of Public Works and the common council of the city.

As to the first reason, it should be said that it is doubtful whether the section referred to in the act of 1876 applies to defendant, for it does not appear that defendant ever accepted the provisions of that act as therein provided. Conceding, however, that the provision is of such a general character as to apply to any company running an inclined plane under whatever law organized, the restriction obviously applies only to places where the inclined plane itself crosses the streets, and not at all to what may be called surface street railroads which the Inclined Plane company is given power to lease and operate as street railroads are usually operated. The conditions upon which the inclined plane is operated, and to which the operation of street railways by the Inclined Plane company is to be subject, must, of course, be such conditions as are applicable to street railroads, of which the condition insisted on is obviously not one. Nor has the second reason, in my opinion, any weight. The original Mt. Auburn Railroad company ran up Liberty, Price, Josephine and Saunders streets. This portion of the road is not used now, but being taken away, it leaves the part of Liberty to Fifth a portion, and that from Mason to the north corporation line a portion. As to the objection that such roads are not necessary to the dispatch of the business of the inclined plane, I think it may be presumed that they are. It is common knowledge that the great difficulty to be overcome in reaching the plateaus about the city was in climbing the hills, and that the instrumentality by which that was accomplished became the principal feature of any such plan. The approach to the bottom and the departure from the top were incidental, and were certainly necessary to get passengers to the place of ascent or descent.

In so far as the third reason depends on the restriction in the grants to the Mt. Auburn railway to the use of horse and mule power, it is quite clear that subsequent legislative action enlarging the right of the lessee in this respect has been had, and no reason is apparent why it is not valid.

The chief argument is based on a construction of the proviso, "provided that no other motive power than ani-

mals shall be used on the public highways occupied by such street railway company without the consent of the Board of Public Works in any city having such a board, and the common council, or the public authority or company having charge, or owning any other highway in which such street railroad may be laid." Counsel for plaintiff argues that the body usually invested with the power of granting franchises for a municipal corporation, is the common council, and that it is not to be presumed that, in this case, the legislature intended to confer final power of that kind on the Board of Public Works, which is a body for the initiation of measures, not for their final legal sanction. Therefore, it is said, the word "and" before "common council" unites these two words with Board of Public Works, and the disjunctive "or" is the dividing word of the clauses, so that by a proper transposition it might be made to read "without the consent of the common council and of the Board of Public Works in any city having such a board, or of the public authority or company having charge, or owning, etc." This construction might be supported but for the use of the word "other" in the second clause. The clause is rather obscurely drawn, but the expression "any other highway in which such street railroad may be laid," means any highway additional to those already mentioned in which the same street railroad has been laid. The law is defining the consents required for one railroad passing through several jurisdictions. Therefore, we have the conjunctive *and* be ore common council to indicate that where a railroad has its beginning in the highways of a city having a Board of Public Works, and extends onto another highway beyond the city jurisdiction, it must have the consent of the common council or the public authority or company having charge, or owning such other highway in which such street railroad may be laid. The bill was evidently passed by the legislature with this city in their minds, for this is the only city in the state where an inclined plane would be necessary, and for this reason the peculiar phraseology is used. It would apply by virtue of the last clause after "*and*" to any other city, but as bearing on the effect of *and*, the probable and possible application of the law may be considered.

While it is true that to the common council is usually given the right to grant franchises, it is certainly within the legislative power to give it to the Board of Public Works or Affairs, and of late years there have been many instances where other powers, like those of passing ordinances to assess, and to make certain improvements, have been transferred from council to the Board of Public Works. Moreover if, by this law, the legislature intended to make the consent of the Board of Public Works and council necessary, it was wholly superfluous to have mentioned the board at all, because, under Section 2227 Rev. Stat., the common council could not grant such consent except upon the approval of the board Some point is made of the presence of a comma after the words "common council" in the certified copy of the bill obtained from the secretary of state's office, which does not appear in the printed law. I cannot see that this materially affects the construction given above, for the certified copy shows the comma between board and the following *and* just as the printed law does, and that is the point where the question of a separation is important in construing the proviso.

On the whole, then, I am of opinion that the legislature conferred the right upon defendant to use any other motive power than animals, whenever the Board of Public Works should consent. Now, the board did consent, on October 24, 1885, that defendant should use either a cable, compressed air, or electricity. It has chosen electricity and has procured the necessary authority to erect its poles and string its wires.

Such being the condition of the franchises which the plaintiff and defendant are lawfully entitled to enjoy, considered each without reference to the other, it becomes necessary to inquire first whether any loss has been inflicted upon plaintiff by defendant, and if so, how it has occurred; second, whether such loss, if any, is justified by defendant's franchise, so as to be *damnum absque injuria*, which involves the preliminary question whether the legislature, after having given the plaintiff the right to construct its telephone system, on the faith of which right it has expended large amounts, can confer a franchise on another, the exercise of which will seriously impair the plaintiff's franchise as heretofore enjoyed.

First, a current of electricity cannot be produced without a circuit, that is, unless the negative and positive poles of the generating battery or instrument are connected by a continuous substance, capable of conducting the current. Such a substance may be a metal wire, or if both poles of the battery be connected with the earth by metal wires, the current will find a circuit through the wires and the earth. The earth, by reason of its immense mass, makes an excellent conductor. By what paths the current discharged into it over the wire from one pole finds its way throughout to the wire from the other pole, is not capable of determination.

The telephone is a mechanism by which the sound of human speech is reproduced over long distances. Without attempting to describe the exact mode in which this result is brought about, I may say that the sound waves of the human voice produce vibrations in a thin ferrotype plate, which, by means of a magnet and an induction coil, are converted into corresponding variations in an electric current on the connecting wire, and these variations are, in turn, by means of the inducing coil and magnet at the other end, converted into exactly corresponding vibrations on a plate there, reproducing the sound waves of the voice of the speaker in such a manner as to enable the receiver to understand. The current on the connecting wire is a slight one, and the circuit is completed, not by a return wire, but by a ground wire brought into contact with the earth. This contact is usually made by attaching the wire from the negative pole of the single cell battery in each telephone, to a gas pipe or water pipe running down into the earth.

In the Sprague system of electric railways, which is the kind used by the defendant, the electricity used to operate the motors under the cars is conveyed to them by a single overhead wire suspended over the middle of the track, along the under side of which runs a trolley wheel on a single mast attached to the car, making electric connection between the overhead wire and the motor of the car, and allowing the current to pass down through the motor and onto the track, whence some of it returns directly to the dynamo generator at the power house. A large part of the electricity leaves the track, however, and by other and various paths, also finds its way through the earth back to the dynamo. In addition to the overhead trolley wire, which is supported by guide wires from iron posts erected on the curb at regular intervals, there is what is called a feed wire strung along on these posts for the purpose of keeping up the required quantity of electricity on the trolley wires. On the streets where are telephone wires and electric railway wires, their general course must be parallel. The evidence in the case establishes beyond a doubt that, since the defendant began the operation of its line by electricity, in June, 1889, down to the time of trial, the usefulness of all the telephones along the line of the railway have been more or less impaired; that, in many cases, the buzzing noise, which seems to be the chief form of the disturbance, has been so loud and continuous that communication over the lines has been impossible. Nor has the disturbance been confined to telephones on the line of the railway. Telephones several miles from the city, whose connecting wires ran parallel for any distance with the railway, were similarly affected, and the buzzing noise, in many of these, seems to have been quite as deafening as in telephones along the line. Altogether, more than two hundred lines have been affected in this way, to a greater or less degree. The cause of the trouble is undoubtedly the operation of the electric railways, and the way by which it is brought about is two-fold. First, the escape of the electric fluid from the rails, which is called earth distribution or leakage, near where the wire from the telephone is connected with the earth, brings upon this earth connection wire of the telephone varying currents of electricity of much greater quantity than that necessary for the telephone current, and produces upon the magnet and inducing coil an effect which results in vibrations of a very different character from those produced by the human voice, and makes a noise like the buzzing of a saw; second, a similar noise is made by induction. It is a physical fact of much importance in electric mechanism that, where two wires of two circuits are parallel to each other, and there is a current of varying intensity on one of them, this will produce in the other, in the opposite direction, a current of electricity of similar variation. The insulation of the wires has no effect to reduce the current produced in this way. The amount of induction depends upon variation in the current, the distance of the wires from each other, and the length of the parallelism of the wires. The current upon the trolley wire and the feed wire of the railway is quite variable in quantity and intensity, owing to the drain upon the store of electricity by the moving and stopping of the car. Nor is the electricity, as generated, exactly uniform in its flow from the dynamo. The result is that, wherever the telephone wire is parallel with the trolley wire and the feed wire, there is induced upon the telephone wire a current whose variations correspond with the variations of the electrical current on the electric railway wires, and this, acting upon the inducing coil and magnet, produces vibrations of the tin plate, which makes the buzzing sound It is not possible, in listening to the sounds produced by the electric railway, to say whether it is the result of induction or earth leakage. Some of plaintiff's subscribers, notably Proctor & Gamble, have loud buzzing sounds upon their telephones, the ground wires of which are at such a distance from the railway track as to make it quite unlikely that the disturbance could have been caused by earth leakage, while, on the other hand, their wires are for some distance parallel with the trolley and feed wire of the railway company. Other telephones are disturbed on the line of the road, though their wires are not parallel with the trolley wire. Expert evidence attributed the disturbance about one-half to induction, and one-half to conduction or earth leakage. This, of course, is only a rough estimate, and the fact may vary much in particular instances. The injury to plaintiff's service is produced then, speaking in a general way, one-half by the defendant's pouring electricity into the earth, which finds its way into the property of plaintiff's subscribers, and thence into the wire of the telephone, and one-half by a creation of a current on plaintiff's wires in the street by the parallelism of defendant's wire and the varying character of the current. The result has been a very substantial interference with the plaintiff's business, and if the present condition continues, it will end in a serious loss.

Is it a loss for which defendant is liable? The contention on behalf of the defendant is, that because it has full power to operate by electricity under the law, the loss resulting to the plaintiff is *damnum absque injuria*, and if the plaintiff wishes to avoid the loss, it must adopt safeguards in the shape of a metallic circuit to avoid the difficulty. To this plaintiff replies, that, by virtue of its grants it acquired, before the defendant had a right to use electricity as a motive power, a vested interest in the telephone system as it now operates it, with a grounded circuit, and that not even the legislature of the state could take away from it or injure this franchise, on the faith of which it has expended so much capital and labor.

I am inclined to think that, under the constitutional provision that all laws for the forming of corporations may be altered or repealed (Sec. 2, Art. XIII), it would be in the power of the legislature to grant a right to other corporations for a public use to so use the street as to require the plaintiff company, if it wished to continue in the telephone business, to change its system, and that without any right of action against such corporations. The case of Railway company v. Railway company, 30 Ohio St. 604, shows that, where one railway company condemned a right of way across the track of another, that other cannot recover for an injury to its franchise as a railroad, or for the increased expense entailed upon it in obeying laws of the state with reference to railroad crossings. However this may be, I am very clear that no intention on the part of the legislature to abridge the granted rights of one corporation by a new grant to another will be recognized by the courts unless such intention plainly appears in the law. In England the power of parliament is unlimited, and it may even confiscate private property, and *a fortiori* may abridge and destroy chartered rights and franchises. Nevertheless, we find in that country, that where one corporation is granted a right which may be so exercised as to injure or interfere with a right previously granted to another, the presumption of law is that parliament intended only such uses as were consistent with the rights of the first corporation. In Gas Light & Coke company v. Vestry, 15 Q. B. D. 1 plaintiff was a gas company which had laid its gas pipes by virtue of a public grant under a street which the defendant, a public corporation, was charged with keeping in repair, and upon which it used such heavy rollers as to injure the pipes of the plaintiff. The rollers used were economical and well fitted for the purpose, but it was held that, unless the defendants were expressly authorized by statute to use rollers of the size and weight of those which did the injury, the defendant could not justify under a duty to keep in repair which might be discharged by rollers of less weight and without breaking the pipes. Says Findley, L. J.: "The authorities . . . show that an action lies for injury to property unless such injury is expressly authorized by statute, or is, physically speaking, the necessary consequence of what is authorized. If in this case the defendants were expressly authorized by statute to use steam rollers of such a weight as necessarily to injure the plaintiffs' pipes the plaintiffs would have no ground of complaint. The case would then be one of *damnum absque injuria*. The same consequence would follow if the defendants were expressly authorized by statute to repair in some way which necessarily required the use of heavy steam rollers or other machinery, which could not be worked without injuring the plaintiffs' pipes. There again, although such rollers or machinery were not expressly mentioned, their use would be authorized by necessary implication, and the plaintiffs would be without redress. But unless some statutory enactment can be shown to authorize the defendants to injure the plaintiffs' pipes, the plaintiffs are entitled to redress." This case is peculiarly applicable to the case at bar, because here was a case of a public grant to the gas company enjoyed in a certain way, followed by a grant to the defendant to exercise another right, which if exercised in one way would injure plaintiff's enjoyment of its right, and which if exercised in another would not. The same principle is here applied that courts recognize wherever private property is injured by the exercise of authority granted by the parliament. (See Hammersmith, etc., Railway company v. Brand, L. R. 4 H. L. 171. Queen v. Bradford Navigation company, 6 B. & S. 631. Geddis v. Proprietors of Bann Reservoir, 3 App. Cases, 430. Att'y Gen'l v. Colney Hatch Lunatic Asylum, L. R. 4 Ch. App. 416. Att'y Gen'l v. Gas Light & Coke company, 7 Ch. D. 217. Managers Metrop. Asylum District v. Hill, 6 App. Cases, 193.)

Even then, if franchises to occupy the public streets conferred by the legislature may be subject to modifications of their use and enjoyment by other public grants of the legislature, it is certain that unless the legislative intent to make such modification clearly appears, either by express words or by necessary implication arising from the impossibility of enjoying the second grant without such modification, it will not be inferred.

But it is said that this principle can have no place here because the right to occupy the street for the purpose of travel is a superior right to that of using it for the telephone poles. Defendant's counsel, to establish this, rely on The Spring Grove Ave. v. Cumminsville, 14 Ohio St., Smith v. Telephone company, 2 C. C. R. 259, Mt. Adams & E. P. R. company v. Winslow, 3 C. C. R. 425, R. R. company v. Williams, 35 Ohio St. 171, Pike's Ex'rs v. Western U. Tel. company, decided by this court.

These cases have no bearing upon this case at all, as it seems to me. They involved a discussion of whether the erection of certain structures in the street could be considered a new burden and use, not included in the easement, which the abutting property holder had originally granted to the public, and whether therefore he was entitled to compensation. It is unquestionably within the power of the legislature, so far as the public is concerned, to enlarge the benefit to be derived from the streets, so as to include other public purposes than those of mere travel. (Railway company v. Lawrence, 38 Ohio St. 45.) If this takes more from the abutting property holder than he originally gave, then he may have compensation, but the public cannot complain, for their representative, the legislature, has spoken and granted the use. When the telephone company is granted the right to use the streets, its right is as well founded as that of a street railway company, and in the absence of express legislative direction to the contrary, there is to be no yielding to any other. The provision that the telephone and telegraph lines shall not incommode the public in the use of the street, in Section 3461, does not help the defendant. The inconvenience must be determined when the enjoyment of the franchise is entered upon. After rights have been acquired by the outlay of capital and user, there must be express legislative sanction, at least, to warrant a court in finding a use of the street to be an interference with public travel, which was not so when it began. It should be noted in this connection, too, that the plaintiff performs a very important *quasi* public duty, and is in fact a common carrier of messages. It is given the power of condemnation on that ground alone. (Pierce v. Drew, 136 Mass. 75. Hockett v. State, 105 Ind. 250)

Coming now to apply the principle just under discussion to the case at bar, what do we find? For ten years the plaintiff has exercised the franchise of occupying the streets along defendant's lines with its poles and wires conducting a telephone business with a single wire circuit and an earth return. This mode of return was universally employed when it began, and is to-day in general use. It has constructed a valuable plant, many parts of which will have to be changed at great expense if it is to adopt the only sys-

tem which will obviate the difficulty it now encounters from the operation of defendant's railway. I refer to the metallic circuit. It is admitted by every one that if the telephone company were to make every one of its lines a complete metallic circuit, with the return wire parallel with the outgoing wire, the disturbance both from induction and earth leakage would be completely removed. It is obvious that if the circuit never came into contact with the earth, the electricity dumped into the ground by defendant could not reach the telephone wire, and so no disturbance could arise there. And it is also a well-ascertained fact that if the two wires of the circuit, the outgoing and the return, are parallel and the same length, no effect will be perceptible from induction by a third parallel wire of another circuit, however variable may be the current on that wire. This is because the induction, which actually takes place upon each of the wires of the circuit, results in currents of equal intensity and variability in opposite directions, which, being on the same circuit, exactly neutralize each other. To construct such a circuit for every subscriber would entail an expense upon plaintiffs, perhaps, even greater than the original outlay. Nor does it seem practicable to have metallic circuits in disturbed districts and allow the other lines to remain grounded because of the difficulty in arranging the switch-boards at the exchange by which subscribers are connected with each other, and for the further reason that in order to connect a metallic circuit with a grounded circuit, the return wire of the metallic circuit must be grounded at the exchanges. The result is that the circuit then made between the two subscribers is a grounded circuit with a long leg and a short leg of wire parallel in the disturbed district. The difference in the length of the two wires prevents the neutralizing effect of the induced current in one wire upon the opposite induced current in the other, because, by reason of the different lengths, that part of the induced currents said to be produced by static induction is unequal. Moreover, to put up metallic circuits through the disturbed districts, and to make the necessary alterations in the switch-board, would entail an expense, not nearly so heavy, of course, as a complete conversion into a metallic circuit, but which would be quite substantial. There remains to consider what is called the McCluer device, which consists in a large wire carried into the disturbed district with which are connected all the return wires of the telephones. This main wire is grounded at a point away from danger of earth leakage. It is likely that such a device would get rid of earth leakage, but it would have no practical preventive effect upon the disturbances by induction, which, as I have said, make up about half of the troubles. The expense of such a device would not be large, still it would be something. It follows, from what has been said, that if the defendant is permitted to use its present single trolley system, it will require the plaintiff either to lose the business of many subscribers, or it will have to go to an enormous expense to obviate all difficulty, or to a less expense to get partial relief.

The plaintiff invested large capital on the faith of its present mode of enjoyment of its franchise. It has continued in such enjoyment for some ten years. To change involves loss and expense. Clearly, then, it cannot be deprived of what so nearly approximates a vested right without clear legislative intent. The defendant cannot be the instrument by which such loss is occasioned unless it clearly appears, and upon it is the burden to show that, in no other way, can it enjoy the right to use electricity for its cars. --(Atty. Genl. v. Gas company, 7 Ch. D. 217) It is true that the resolution of the Board of Public Affairs approved its plan of structure, but as the legislature in allowing the defendant to use electrical propulsion upon consent by such board is not presumed to have intended a use which would injure plaintiff unless no other use is practicable, so it cannot be presumed to have given the board power to consent to such use. Moreover, the consent upon which defendant relies was the resolution of the Board of Public Works in 1885, which defined no system of electricity.

Is it impossible, then, for the defendant to run an electric railway along its streets without making these disturbances? It is practically conceded, although there was some slight evidence to the contrary, that if instead of a single trolley wire and an earth return, two trolley wires were used, one for the positive and the other the negative current, the difficulties would be just as completely obviated as if the telephone company used a metallic circuit. There is such a system in use in a number of cities of the country. There are two in operation in this city, and two or three more are projected here. In such a system the electricity is carried from one wire down through one trolley wheel and mast to the motor of the moving car, and returns from the motor to the other wire by means of a second trolley wheel and mast. It is said it is wholly impracticable.

The single trolley system is in use on nine-tenths of the electric railway systems in the United States. This arises doubtless from two facts: First, that it is perhaps one-fourth cheaper in its outside construction; and second, because in single track railways, of which there are many more than double track, where it is necessary to have many switches and turn-outs, the complications of wires overhead increase much more rapidly with a double trolley than a single trolley. But in the case at bar we have a double track from one end of the road to the other, so that no switches are required. Mr. Short, who is a skilled mechanician engaged in a company which bears his name, and which erects both the single and the double trolley systems, says that he recommends the single trolley for single tracks, and the double trolley for double tracks. He seems the only witness on either side that is free from suspicion of bias.

It is admitted by many of defendant's witnesses, that electrically the double trolley system is exactly as good as the single trolley, and this must be so, because a return by wire makes quite as good a current as by the earth. The claim that electricity in the wheels passing to the track gives additional traction is conjectural, and is not apparent in a practical comparison of the grades ascended by the cars on the two systems. The objection to the double trolley system is the mechanical difficulty in making proper switches and in supporting the superstructure. In the double-track road like the defendant's, the first difficulty does not arise, and the second difficulty has in fact been overcome in every double trolley system which has been erected. On the whole, then, it seems to me that there is no serious obstacle to defendant's using the double trolley. A change will no doubt involve the defendant in substantial expenditures in the overhead structure, which will have to be made heavier. But nearly all of the material can be used again, and no material changes need be made, either in the dynamos, engines or motors.

The defendant cannot rely on an estoppel. It was notified by the plaintiff as early as March 12, 1889, some three months or more before its electrical plant was put into position, that the use of the single trolley system would interfere with and injure the use of the plaintiff's telephone lines. Defendant promised plaintiff that the system was an improved one, which would give rise to no trouble. In so doing, it relied on the assurance of its vendor, the Sprague company, and the peril of the fulfillment of such assurances must lie with it.

But it is said that the injuries here occasioned are not cognizable in the courts, even if the telephone company is to be regarded as a private property owner in the enjoyment of the telephone franchise, and the case of *Frazier* v. *Siebern*, 16 Ohio St. 614, is relied on in this connection. That was a case between adjoining proprietors, where the defendant dug a well on his premises and knowingly diverted percolating waters which made a spring on the plaintiff's premises, and dried the spring. This was held to be *damnum absque injuria*. There is no parallel between that case and the one before us. There the spring owner had no ownership in the percolating waters until they appeared on his property, and the injury he suffered arose simply from his neighbor making his own that to which, while it was on his premises, he was lawfully entitled. In the case at bar, the disturbances, in their two-fold origin, present slightly different circumstances, but call for the application of the same principle. The earth leakage arises from the defendants pouring electricity into the earth, which, following a course as natural for it as the seeking of a lower level is for water, comes upon the premises of plaintiff's subscribers, and by getting upon the wires of the telephone, does harm. The plaintiff, by contract with its subscribers, has a right to have its wire where it is, and, for the purposes of this discussion, has exactly the same right to object to the presence of electricity on his premises caused by defendant and resulting in damage, as would the subscriber himself. It is impossible to distinguish such an injury in principle from the case of one discharging filthy waters into the ground so that it shall percolate into another's premises and there do damage, or of one's causing smoke and cinders to be constantly thrown into one's windows and injuring one's enjoyment of one's property. These are all examples of nuisances which have been held to give a right of redress. —(Ballard v. Tomlinson, 29 Ch. D. 115, Ry. Co. v. Gardiner, 45 Ohio St. 309.)

In Reinhardt v. Mentasti, 42 Ch. D. 685, it was held to be a nuisance for the defendant, a pastry cook, to put in a room in his house, which adjoined a room of the plaintiff long used as a wine cellar, a stove so large that, when it was being used, it heated the wine cellar, and made it useless for that purpose.

In Attorney-General v. Gas Co., 7, Ch. D. 217, the creation of noisome gases was held a nuisance. How can injury from electricity be distinguished from an injury by water, gas, smoke or heat? The term nuisance signifies anything that causes hurt, inconvenience. annoyance, or damages. Columbus Gas Co. v. Freeland. 12 Ohio St. 392.

As was said in Reinhardt v. Mentasti 42 Ch. D. 685, "The principle governing the jurisdiction of the court in cases of nuisance does not depend on the question whether the defendant is using his own reasonably or otherwise. The question is, does he injure his neighbors?"

The disturbance by induction is of similar character, except that the force is applied from one wire to the other through the air instead of the earth. If, as we have found, defendant is not entitled to interfere with plaintiff's enjoyment of the telephone franchise, here is a direct act of interference. I presume that, if one man arranges a set of mirrors, with reference to the sun, so as to concentrate its rays upon his neighbor's property, and so burns and damages that property, no question would be made of his liability. What difference can there be between such a case and the inducing of a damaging current on plaintiff's wires? The way in which the force acts may not be as well understood in the case of the mirrors and the rays as in that of electric induction, but the fact of the cause and the result is quite as clear. The contention by the defendant that the plaintiff, in resisting injury which reaches it through the medium of the earth and the air, where the defendant is the known moving cause of such injury, is making a claim to the exclusive use of the earth, is misleading, not I it is examined, when it becomes apparent that the same claim might be made as to percolating waters, as to heat, as to smoke, and as to odors. The fact is, nuisances are generally injuries arising from a cause which is not in contact with the property injured, and which must have come through the medium of the earth or air, or the waters under the earth.

Then it is said no claim can arise for disturbances by the defendant, because there are similar disturbances from other causes, for which the defendant is not responsible, and Wood v. Sutcliff, 2 Simons N. S. 163, is cited upon this point. That was a case where the injury sought to be enjoined was the pollution of a stream from which plaintiff had in time past, drawn water for his business. One of the reasons given by the vice-chancellor for refusing the injunction was that others than the defendant were polluting the stream. The real basis of the decision was the laches of the defendant in asserting its right, for he had provided a new supply of water, and had not used the river for some time. This case presented no difficulty in considering the case at bar, first, because there are no substantial disturbances shown, other than those caused by defendant, and second, because the case itself is not sound authority. (See Crump v. Lambert, 3 Eq. Cas. 414, Crosky v. Lightowler, 2 Ch. 478, Walter v. Selfe, 4 De Gex & S, 315.) In the last case, the court said that because one man was maintaining a nuisance against the plaintiff, was no reason why defendant should set up an additional nuisance.

We find, then, that defendant is inflicting a legal injury upon the plaintiff in the nature of a nuisance from which has already arisen loss, and which must inevitably cause loss in the future, constantly recurring. It is said that the damage is not irreparable, because the plaintiff can expend money and avoid it, and, in the same way, can arrive at its exact loss, and that, therefore, its remedy is not by injunction, but at law. Neither of these claims can be sustained. The most frequent exercise by a court of equity of the power of injunction, is to prevent the continual recurrence of injuries from nuisance. The ground is that the plaintiff should not be put to a multiplicity of suits and endless litigation. To say that in order to entitle a man to obtain an injunction against such an injury, that he should not be able, by the expenditure of even vast amounts, to avoid the injury, is to say that no injunctions can ever issue for such a cause. The point is that he is not obliged to expend money to protect himself when a neighbor injures him, but he may appeal to the courts; and when upon the law side, he finds that the remedy there afforded is inadequate because of the necessity for bringing a separate suit for each injury, he may fairly say that by appeals to legal tribunals, he can not repair his damage, and therefore his loss will be irreparable. As to the ascertainment of damages, it is by no means true that in each suit the entire cost of introducing a metallic circuit or a McCluer device would be the measure of damages for this sort of interference, and the very reason for going into a court of equity, is to get into a forum where all the injuries can be considered together.

The authorities are overwhelming that for such injuries as those arising at the bar the proper remedy is by injunction. (Imperial Gas Co., v. Broadbent, 7 H. L. C. 601. Crump v. Lambert, L. R. 3. Eq. Cases, 409. Crawford v. Rambo, 44 Ohio St. 287. Attorney-General v. Cambridge Consumers's Gas Co., 4 Ch. App. 71. Gas Co. v. Vestry, 15 Q. B. D. 1. Cook v. Forbes, L. R 5 Eq. Cas. 166.)

The order of the court will therefore be that the defendant be enjoined perpetually from the use of the system of electric railway propulsion as now operated by them, or any other which will occasion similar disturbances to those now caused by defendant's single trolley system. The order of injunction will not take effect until six months from this day, with leave for the defendant to apply to the court hereafter for further time, if necessary, in a bona fide effort to make the necesary changes The costs of the action must be paid by the defendant. Decree accordingly.

New York Electrical Society.

Herbert Laws Webb lectured before the New York Electrical society on the 12th inst., on "Puck's Girdle Round the Earth." In opening his lecture Mr. Webb said that the subject of submarine telegraphy was one of such wide scope that it could be only incompletely treated in one evening. In point of fact, an entire lecture might well be devoted to the consideration of the manufacture of cables, another to their submersion, a third to repairing, a fourth to operation, a fifth to testing, and even then the subject would by no means be exhausted.

The construction of the conductor was first described. It consists of a strand of seven copper wires, weighing 106 pounds per nautical mile, the center wire being passed through a compound before stranding the outer wires round it. The dielectric consists of at least three coatings of gutta percha; between the conductor and the first coating, and between the successive coatings, which are to adhere perfectly to each other, is applied a layer of Chatterton's compound. The dialectric weighs 140 pounds per mile. The cable, called in this stage "core," is coiled on reels in mile lengths, weighed and tested, before being passed for the application of the outer protection. The electrical conditions required are as follows: The conductor resistance is not to exceed 12 ohms per nautical mile at 75° Fahr. The electrostatic capacity is not to exceed .37 microfarads per nautical mile at the same temperature; the dielectric resistance after one minute's electrification is not to be less than 250 megohms per nautical mile at 75° Fahr. The outer protection is as follows: The deep sea type is served with tarred jute, put on wet, and sheathed or armored with fifteen No. 13 B. W. G. steel or homogeneous galvanized iron wires. Outside the armoring goes a layer of Russian hemp impregnated with tar or compound, and finally an envelope of tape soaked in compound, two tapes being put on in reverse directions. This makes a pretty good cable, strong and light. The weight wet in air is 1¾ tons per knot, and the breaking strain 5½ tons, the specific gravity compared with sea water being 2.5. The "light intermediate," "a heavy intermediate" and "shore end" types were then described. The speaker also gave a description of the heavier type of shore end cable with double armoring weighing up to twenty tons per knot, which is used for very rocky ground. The completed cable is coiled into large store tanks, and is frequently tested up to the time of its submersion and placing in service. The capabilities of principal cable ships, the "Dacia," the "Scotia," the "Faraday," and the "Silvertown" were next passed under review. On the expedition for the laying of the Central & South American company's system of cables stretching from Lima, Peru, to Salina Cruz on the coast of Mexico; the Silvertown carried 2,370 knots of cable, weighing 4,881 tons, and the entire length was shipped in twenty-two days, or at the rate of over 100 knots per day, the greatest length coiled on board in twelve hours being 65 knots, nearly 5½ knots an hour. In the laying of the ca-

bles, the speed of paying out often reached 9 knots an hour, an unusually high figure, due chiefly to the ease with which coils of such large diameter unwind.

The ship's company of a cable steamer is a considerable one, seldom numbering, on a ship of about 2,000 tons, less than 130 officers and men. The engineer-in-chief is the principal figure, as he has entire charge of the whole expedition. He is supposed to know the whole business thoroughly. He must be able to navigate the ship, take charge of the paying-out or picking-up gear, localize a fault in the cable from the testing room, fit up a telegraph office, and, if necessary, send or receive the message himself. Then comes the captain and the usual ship's officers and engineers. The cable staff consists of engineers and electricians. The engineers look after the mechanical part of the work, and the electricians keep a close watch on the electrical conditions of the cable. Besides these, who are all "officers," there are trained jointers, whose special duty it is to make the electrical joints in the cable, and a large number of cable hands and foremen, together with the usual crew of firemen and sailors. As a general rule, too, the interests of the government or company for which the cable is being laid are watched over by one or more special representatives, who scrutinize every operation with the utmost minuteness.

A description of the various sounding instruments was given by the lecturer, who illustrated the importance of a thorough survey of the ground before the submersion of a cable by an account of soundings made by the Dacia between Cadiz, Spain and Canary Islands in 1883. Several banks were encountered where deep water was believed to exist. One of these banks nearly escaped notice, as the soundings were just then being made at long intervals; but a suspicious shoaling was noted on comparing one sounding with the previous one, and a little further on deeper water was found. The ship was put back, stopping to sound every few miles. The depth decreased very rapidly and excitement ran high when the sinker finally found bottom at 68 fathoms. They had found a submarine mountain, raising its crest to within a few hundred feet of the surface, rising precipitously from a depth of nearly 2,000 fathoms. This bank was exactly on the proposed course of the cable, to the existence of which it would have proved fatal had the intended line been followed. Three days were spent in surveying and determining the limits of the bank, which is now marked on the admiralty charts as "Dacia Bank." The cable steamer Seine found a similar bank in the same part of the Atlantic some years previously, but she did not find it by sounding. She was laying a cable from Madeira to Lisbon, and discovered the existence of the bank when laying the cable right across it. The cable festooned and broke and something wrong was naturally suspected on board the Seine. When making the repairs soundings were taken, and a shoal, now known as the 'Seine Bank" was discovered.

The first shore end of a cable is generally laid a few miles out to sea and the cable cut and buoyed. The ship then makes for the other terminus of the line, lands the shore end there, and starts paying out toward the buoy on the first end.

The *modus operandi* of these operations, with all their intermediate steps was detailed by Mr. West, in a very interesting manner.

The duties of the electrician who makes the continuity tests are very responsible, and frequently the source of considerable anxiety. For exchanging messages between ship and shore, if the cable is a short one, a double current Morse instrument is used, but with longer cables the mirror is employed. During the laying of the final section of one of the Central and South American cables, as the electrical staff had been much reduced in numbers owing to necessity of detailing some of them for extra shore work, the secretary of the expedition was pressed into service to do a little "spot watching" in the ship's testing room. Paying out was being carried on at a pretty high speed and a slight accident happened in the tank, a couple of turns coming up together and fouling a lantern at the side of the tank. The turns, however freed before reaching the machinery, and it was hoped that no damage had been done to the cable. The newly-recruited electrician, who felt the responsibility of his position very keenly, was particularly cautioned by the engineer in charge to keep a very careful watch, and to advise him without a moment's delay if the least unsteadiness in the spot manifested itself, as it was feared the slight accident might have resulted in a fault. All went well for a short time. Suddenly the secretary came rushing out on deck with the information that the spot was off the scale. The ship was promptly put to full speed astern, paying out was stopped, and the cable was made fast, and all hands repaired to the testing room, where it was found that the galvanometer lamp had gone out. When it was refilled the spot re-appeared in its proper place, and the secretary never afterward failed to see that his lamp was properly trimmed.

Mr. Webb closed his lecture by some remarks on repairing, which he said is the most thankless and difficult part of a cable engineer's work. Landing shore-ends and paying-out are mere pastimes compared with repairing in deep water. There is a considerrble element of luck in it too. Sometimes the cable is hooked at the first drag, and at others weary weeks are spent dragging to and fro over the line of the cable, without ever getting a bite. These long delays sometimes render repairs immensely expensive. Some repairs to one of the Atlantic cables not many years ago cost over $400,000. The ship was out for weeks on the Atlantic, and had to put back to port for coal without having accomplished anything.

The Westinghouse Electric company obtained the following orders during January for central station plants: Alternating current apparatus, Jacksonville, Ill., 750; Allentown, Pa., 1,500; Elmira, N. Y., 750; Red Oak, Ia., 750; Gouverneur, N. Y., 750; Uxbridge, Mass., 750; London, Eng., 15,000; Sacramento, 1,500; Hampton, Va., 750.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 22.—The problem of the wires is still unsolved. The past week has been one of unusual activity on the part of legislators, electric light men, electricians, and the Board of Electrical Control. They have endeavored to adjust differences and come to some understanding but just as the public was expecting something, another injunction was obtained, the case must be argued and the city must remain in darkness. The Standard Electrical Subway company, which represents the Westinghouse interests expected to receive the award of contract for the construction of the subway but the temporary injunction obtained by the Manhattan Electrical company restraining the Board of Electrical Control from awarding the contract to the Standard company, must have a hearing before further action can be taken. The mayor said that it was not his intention to make the contract exclusive, but the right to build extra subways could be granted at any time.

The legislature is at work in the direction of burying the wires and Senator Erwin's Senate committee met last Saturday to examine witnesses. In the interests of various electric companies there were present Paul D. Cravath, George Bliss, E. P. Wheeler and Lawrence Godkin. Coroner Levy and his deputy, Dr. Jenkins, testified as to the manner of death of victims of the electrical current, and strongly advocated burying the wires. Expert testimony will be taken on the question of regulating high tension alternating current. During the week several of the electric lighting companies have taken the responsibility upon themselves of making connections by means of overhead wires with the subways, and are beginning to operate their lines.

The death of inventor Albert L. Johnson, in whose favor Judge Lacombe recently rendered a decision in a patent case of long standing, occurred Wednesday. Mr. Johnson, whose headquarters were at the John Stevenson Car company's office has been following up certain alleged infringers of his automatic switch and was about to receive his reward of damages, which he had spent the larger part of a fortune in proving. Nearly all street car lines in this country use his safety automatic switch and many street car builders use other inventions of his in traction.

The stock and franchises of the Essex Passenger Horse Railroad company were transferred to a syndicate at Newark, N. J., Wednesday, on payment of $1,800,000. The purchasers also assume a mortgage of that amount. Rapid transit will be introduced, and it is announced that an electric system will probably be installed.

The legislature this week had two important electrical bills before it. One of them, which was passed early in the week provided for placing the electric railroads under the same protection as other roads, making it a felony to tamper with the wires, tracks or fixtures. The second measure was a telephone bill introduced by Assemblyman Clarke. It restricts the price of ordinary telephone service in cities of over a million inhabitants to $84 a year. Special prices for special service or special wires are provided for. Last year's telephone bill, which failed to pass, fixed the price at $100. A violation of the provisions of this act is made a misdemeanor, and the violator is made liable in a civil action for damages. The violator is also liable in the sum of not less than $50 nor more than $500 for each offense. One-half the amount to be paid to the state and the remainder to the county where the offense is committed. Special and exclusive lines are excepted.

The legislature has also two bills affecting the electrical exemption law. The first provides for the omission of the provision for the suppression of the publication of a detailed account of the executions, and the other provides for the abolishment of capital punishment altogether. This last act will, if passed, change the section of the penal code from "murder in the first degree is punishable by death," to "murder in the first degree is punishable by imprisonment for the offender's natural life." In this connection it is interesting to note that Judge Fish, who sentenced Joseph Chapleau to be executed at the state prison at Dannemora, has filed an opinion in which he calls attention to the question arising in relation to the execution of the death penalty by the warden of the prison. The opinion defines the duties of the warden, who is required to invite a certain number of persons. There is no requirement that any of these persons shall accept the invitation and attend the execution. The meaning and the intent of the law are not clear, according to the opinion. Attention is also called to the failure to provide for the presence of an expert at the execution. The remedy which Justice Fish suggests is that in selecting the medical men and in appointing deputies, the warden shall try to find one who is an electrical expert. The judge evidently has little confidence in the lord high executioner.

The electric lighting of the Metropolitan Museum of Art by the isolated Edison plant is nearly completed and in a very few days the grand collection of the famous masters will show forth in a splendor that was never dreamed of by their creators.

Mr. Jenks, assistant to Major Eaton, counsel for the Edison Electric Light company, gave a very interesting lecture with the use of the stereopticon before the electrical section of the employes of the Pennsylvania railroad at Altoona. The railroad company has built a handsome club house, with a large library and other interesting features for the entertainment and improvement of its employes at Altoona. The interest in electricity displayed by quite a number, has caused the formation of an electrical section, and it was before these young aspirants that Mr. Jenks gave his interesting lecture.

Since the stranding of the sound steamer, "The City of Worcester," it has been decided to place large electric search lights on all the Sound steamers, making it possible to distinguish objects at a distance of half a mile.

The officers of the Metropolitan Telephone & Telegraph company, recently elected, are: Charles F. Cutler, president; John H Cahill, secretary; William R. Druier, treasurer; Joseph Kavanagh, assistant treasurer; William T. Benchelle, assistant secretary; S. T. Guerry, auditor; William H. Eckert, general manager.

A dinner was given E. O. Madden of the Empire City Electric company at the Hoffman House before his departure for Europe. The tables were artistically trimmed with smilax and cut flowers and in the center of the table, was a floral design of a ship with the motto, "Bon Voyage to E. O. M." H. L. Storke presided, and the following named gentlemen were included in those who responded to sentiments: C. W. Price, E. T. Gilliland, S. S. Wheeler, J. J. Carter, B. Coggeshall Chamberlain, P. T. Brady, Cooperstown; E. A. Leslie, W. D. Sargent, A. H. Patterson, T. W. Toppan, F. B. Crocker, F. C. Timpson, Frederick Lines, Chas. P. Bruch, D. Killecutt, G. L. Austin, W. L. Candee.

Thomas A. Edison celebrated his 44th birthday anniversary recently. The employes of the Edison Phonograph works in honor of the occasion decided to make for him the most perfect phonograph possible. They have been working on the machine for the last two months. Every part of the instrument capable of it is plated with gold and silver, and the parts are finished to the utmost possible limit. Attached to the machine is a water-motor of improved construction that has been one of the recent triumphs of the great inventor, and that runs the machine steadily and noiselessly with a minimum consumption of water. The case is of rare inlaid woods, and is a marvel of painstaking workmanship. It was placed in the library during Mr. Edison's temporary absence, and was accompanied by a suitable note requesting him to accept it from the employes of the works.

The members of the New York Electrical society recently listened to a lecture by Herbert Laws Webb on "Puck's Girdle around the Earth." The lecture was a thoroughly practical explanation of the construction and laying of ocean cables, and will form a valuable addition to the literature on that subject. W. H. T.

Indianapolis, Ind.

INDIANAPOLIS, Feb. 20.—The Edwards Railroad Electric Light company of Indianapolis has been incorporated, with a capital stock of $1,500,000 in $100 shares. The directors are Edgar A. Edwards, Charles G. Jenner, Charles L. Doughty and W. N. Gray of Cincinnati, and Walter T. Cox of Indianapolis. The object of the company's formation is the manufacture of dynamo-electric machines, arc and incandescent lamps, electric locomotive headlight apparatus and machinery for lighting cars.

Manager Schaffer of the Citizens' Street Railway company, said recently that all arrangements were now complete for beginning work on an electric street railway line. Illinois street has been selected as the first thoroughfare to be equipped. The line is to run from the Union railway station to Fairview park, a distance of six miles. The Base Ball park and Crown Hill cemetery are included in the route. The contract has been completed with the Thomson-Houston Electric company. The company intends to put on 10 motor cars at the start, each equipped with two 15 horse power motors. It is expected each car will be able to haul two additional cars in case of necessity. Ornamental iron poles will be erected in the center of the street between the tracks to carry the overhead conductors. The work of tearing down the old street car stables near Union railway station, to make room for the power house, 100 feet square, will be begun soon. Two generators of 80 horse power each, a 250 horse power engine, and 500 horse

power boiler will be put in at first. New iron for track has been ordered. If this line proves successful, and it undoubtedly will, other lines will be equipped with the electric system. M.

Kansas City, Mo.

KANSAS CITY, Feb. 22.—Major Davenport has received a letter from J. S. Deckle of Cleveland, O., stating that the business men of that city were actively engaged in an effort to secure a reduction in telephonic rates, and asking for information.

The first of this year in the two Kaosas Cities, there were 2,580 telephones, almost 100 more than a year ago. Sixty operators are employed in the central office.

A movement similar to the one in Cleveland is afoot in this city, but nothing definite has been done. There are complaints that the rates are exorbitant, but the charge is denied by the telephone companies, who claim if the rates are reduced, they cannot afford to continue in business.

The rates in Kaosas City are the same for business houses aod residences. The charge is $72 a year for each telephone within three-quarters of a mile of the central office. Outside of this radius there is a charge of $6 for every additional quarter of a mile. The fire department telephones and wires are kept up by the telephone company free of charge. The manager's office and three police stations are supplied with telephonic communication without cost.

Instead of a reduction, the company here is talking of increasing the rates, except for telephones in private houses.

At the adjourned aonual meeting of the Kansas City branch of the United States Military Telegraph corps last week, Day K. Smith was elected president, J. D. Cruise, vice-president and D. A. Williams, secretary and treasurer. This is the old staff of officers, except the vice-president. J D Cruise succeeds W. H. Wooding.

The members of the Old Timers' association have joined the Kansas City Electrical society, and they now act with that organization. The national meetings of both these organizations will be held in this city during the week of September 8. At the meeting, the entertainment and reception of the delegates to that convention was discussed. During the meeting letters were read from Senator Cockrell and Congressman Tarsney in reference to a bill to be introduced in Congress for proper recognition of the telegraphers who were in the federal service during the war.

Attorney General Kellogg of Kansas, it is stated upon good authority, will be called upon in a day or two to institute *quo warranto* proceedings against the Kansas City Electric Light company to compel the company to show by what authority it is exercising the privilege of placing poles and wires in the streets of Kansas City, Kan. This action will probably be taken in view of the recent defeat in the district court of the city, on its demurrer to the petition of the Kansas City Electric Light company, for an order to perpetually enjoin the street commissioners from removing the company's poles and wires from the streets.

Councilman Phelps has received a call from a representative of a company having a new electrical invention which it desires to introduce in this city. Mr. Phelps in speaking of the matter, said: "The gentleman called upon me to see about obtaining a franchise from the council, allowing the company he represents the right to erect poles and string wires along the streets for the putting in of what he denominated the 'talking telegraph.'"

A number of persons interested in the Kansas City Suburban Electric railway met at the Midland hotel last week. Work must begin within sixty days after the grading is completed on South Troost avenue. That will be finished before this time next week. Already $21,500 worth of stock has been subscribed. The road could be finished by July 1, just in time to meet the heavy summer patronage. The entire cost of constructing the five and one-half miles and the equipment, would not exceed $85,000. The line will be double track in Brush Creek, and from there on single track with turnouts. The meeting resulted in the appointment of two canvassing committees to visit the property holders and get further subscriptioos. The plan is to put the entire stock, $100,000, in the haods of the property holders along the line; the committee are: First—W. N. Sloan and P. E. Hatch; second—W. S. Woods and H. M. Meriweather.

Considerable comment has been caused here by the decision of the Cincinnati court in the telephone-electric railway case by which the railroad is enjoined from using the single trolley system. W. W. Smith, general manager of the Missouri & Kansas Telephone company, says: "We have experienced the same difficulty that has been complained of in every place where the telephones and electric railways have been contiguous. In St Joseph and Topeka we have had especial trouble, for in these places the electric railways are very complete. In Kansas City the construction of the Armourdale Electric road almost completely demoralized the telephone exchange in that part of the city, until we took measures to find a remedy. The Vine street line does not interfere with any telephones, because there are few near enough to the lines to make any difference. Our plan of avoiding trouble is known as the commoo return wire, and is formed by connecting the ends of all the lines with a common wire instead of completing the circuit by running the wire into the ground. This has been done in the case of the Armourdale line, and in our Topeka and St. Joseph exchanges with fairly good success, and affords a partial remedy for the difficulty. A perfect remedy would be a double insulated wire connecting the central exchange with each telephone. The Thomson-Houston system uses both single and double trolley wires, and where the latter is used no difficulty is experienced, and I believe, they will finally come into general use. In the meantime the common return wire aoswers the purpose to a certain extent, and where the roads have interfered with our lines, which were on the ground first, they have stood the expense of the wire. I think the matter in every case will be settled amicably as far as our company is concerned. The new Northeast Electric road has provided for the common wire in advance of beginoing operations, and I believe a spirit of fairness willl control all the matters of this kind that come up in connection with our company." P.

THE ELECTRIC LIGHT.

The Fernandioa, Fla., Electric Light & Power company has decided to ioerease the capacity of its plant.

An electric light plant for the city is among the probable improvements at Montezuma, Ga., aod negotiations are oow in progress looking to that end.

Cordelia, Ga., has decided to erect an incandescent plant and the contract has been awarded the United Edisoo Manufacturing company of New York.

A press dispatch says: "The Evansville, Ind., Gas & Electric Light company's plants have been sold to the Standard Oil company and Jenney Electric Light company for $700,000. The capital stock of the company is $600,000. With the sale goes a six-year contract with the city government worth about $200,000. The street railway company was also sold to Eastern capitalists at a price supposed to be in the neighborhood of $225,000."

The Capital Electric company has purchased the Nashville, Tenn., Lighting & Power company plant and franchises for $60,000 and will, it is stated, increase the capital stock from $75,000 to $200,000 to make proposed improvements and furnish working capital. It contemplates, it is said, erecting a building 180x100 feet, and boiler house 50x120 feet, and equipping with two 1,500-horse power Corliss engines and about 24 dynamos, also generators and motors, increasing the capacity of the combined plants from 200 arc to 600 arc lights and 3,000 incandescent to 6,000.

Electric lighting on the Pacific coast has progressed rapidly during the last year. The Thomson-Houston Electric company installed eleven alternating plants with a capacity of of 6,900 lamps in California and Nevada, seven direct incandescent plants aggregating 1,930 lights and nine arc plants operating 445 lights. One electric railway was also installed by this compaoy. The Edison company also had a prosperous year, for its report shows that sixteen central stations were established on the coast with a capacity of 11,945 lamps. Twenty-four isolated plants were also installed. The combined capacity of these plants is 6,690 lamps.

THE ELECTRIC MOTOR.

An electric street railway is contemplated at Jackson, Ga.

The San Jose & Santa Clara Electric railroad will be in operation about March 1.

The Los Angeles electric road has been purchased by Topeka, Kan., capitalists.

The Oakland & Berkeley, Cal., Rapid Transit company will soon begin the construction of an electric road.

The Fairhaven, Wash., Electric Railway company has been formed to construct a road through Fairhaven, Bellingham, Sehome and Whatcom.

The Sprague Electric Equipment company of Chicago, has installed an electric railway plant at Sioux City, Ia., and fifteen cars will soon be in operation. J. Marshall Atkinson superintended the construction.

Rochester, N. Y., capitalists bought the franchise for valuable railroad lines at Buffalo last week, and will introduce an electric line. The success of the Rochester investors proved a bitter pill to Buffalonians.

The Cream City Street Railway company of Milwaukee, which recently secured a franchise from the council to transfer its plant into an electric line, has been offered $778,200 by a Philadelphia syndicate, the capital stock being $518,000. The line has not been a paying investment as operated by horses, but the permission to change it ioto an electric system increased its value, and it is now considered a first-class investment.

The commoo council of Rochester, N. Y., has granted the petition of the street railroad company extendiog the franchise of the corporation and granting permission to establish the overhead electrical system of propulsion in place of horses. The company agrees to pay to the city 1 per cent. on its gross receipts for fifteeo years, and 2 per ceot. after that time. The receipts last year, according to the company's statement, amounted to $600,000.

THE TELEGRAPH.

The question of establishing a postal telegraph under governmental cootrol came up before a congressioual committee last week in a modified form. Postmaster-General Wanamaker argued in favor of the establishment of a limited postal telegraph. Dr. Norvin Greeo, the president of the Western Union Telegraph company, and Mr. Chandler, the president of the Postal Telegraph company, had been invited to attend the meeting, but neither of them was present. Mr. Wanamaker said he asked the support of the committee in favor of a short bill investing the postmaster-general with authority to enter into a contract with responsible persoos to connect a certain number of postoffices with each other by telegraph, by leasiog wires and iostruments to be operated by postoffice employes. He was not proposing he said, that the goverooment should purchase or build a telegraph lioe, nor the appropriation of a large sum from the treasury, nor the creating of a new body of employes, but simply the utilization of the office buildings, clerks, and carriers now in use, and by convenience and ecooomy of service greatly to accommodate the public in a business that should not be divorced from the postoffice, as it was oothiog more or less than the carrying of messages. He said he proposed a uoion of post and telegraph on a basis that, in his judgment, would not interfere to any appreciable extent with aoy existing rights, but that would offer incalculable service to classes not now enjoying the use of the telegraph to aoy large degree. He asked that he be directed to negotiate for aod secure a set of leased wires, such as the great newspapers have from city to city, or brokers and bankers have connecting their offices in the differeot cities, so that "the common people" might communicate through their business offices (the postoffices) from city to city, or by messages dropped in the mail boxes. The postmaster-general believed his proposed scheme would not conflict with the business of the Western Union or Postal companies, but would create a new line of business such as was established in Great Britain, where 50 per cent. of the telegrams handled are of a social character against 5 per cent. in this country. At a second meeting of the committee the postmaster-general continued his argument in favor of the government assuming control of the telegraph lines, though at first the service be but limited. Mr. Chandler gave an account of the extent of the system of the Postal Telegraph company and the relations of his company with the Western Union. These relations are mutually protective, but would not prevent his company from entering into a contract with the government for postal telegraph service. He was entirely opposed to the establishment of telegraph lines owned by the government, for that would seriously injure if not destroy millions of dollars invested in the property of his company.

Personal Mention.

Charles W. McDaniels of the Missouri & Kansas Telephone company, Kansas City, was in Chicago last week.

W. H. Van Sickel, manager Edison Gas, Light & Power compaoy of Sault Ste Marie, Mich., was in town last week.

Thomas Evershed, a distioguished engineer, died at Rochester, N. Y., last week aged 73 years. The deceased at the time of his death occupied the position of division engineer of the western division of the Erie canal. He was one of the most prominent men in his profession, and in 1881 was candidate for the office of state surveyor, receiving a highly flattering vote. Among the numerous projects with which he has been identified, none occupied more of his attention than his efforts to solve the problem of utilizing the power of Niagara. He was interested in a company which was formed with a view to establishing an electric power station at the falls, and was personally interested in the preparation of the plans and specifications for this undertaking. As he was an enthusiastic believer in this project, his death will undoubtedly be a set back to the company.

Business Mention.

J. H. Bunnell & Co., of New York, have taken the sole agency for the Burnley dry battery for this country, and are meeting with considerable success in presenting it to the public.

The Knapp Electrical Works, Chicago, has been shipping large orders of telegraph instruments. This house has also had a large run on its annunciators for hotels and residences.

The *Western Engineer* of St. Louis, devoted to the interests of mechanical, steam aod hydraulic engineering presents a creditable appearance, and will undoubtedly meet with favor in its field.

The Triumph Compouud Engine company has recently sold to Gen. Andrew Hickenlooper, president of the Cincinnati Gas, Light & Coke company, two 250 horse power engines for use in the new station.

The progress which the Interior Conduit & Insulation company of New York is making, shows the interest that is everywhere felt in this most important branch. Recently, on invitation of President Johnson, electrical experts from all the large cities in the country witnessed a test at the Bergman company's factory, and all expressed themselves not only satisfied but surprised at the progress that has been made so recently by this company. Mayor Hart of Boston was an interested spectator. Many aldermen and members of the city council of that city, together with the following named gentlemen, were present: Fire Marshal Whitcomb, Superintendent of Fire Alarm Flanders, Dustin Killecutt, inspector of the Boston Board of Fire Underwriters. After the test had been completed Mr. Johnson

invited the visitors to a lunch at the Hoffman House, where the system was thoroughly discussed and acknowledged an excellent move in the right direction. Prof. Barker of the University of Pennsylvania, Mr. Murphy of the fire commission of Boston, Wm. H. Sayward, president of the Builders' Association of Boston, F. W. Whiting, secretary of the Philadelphia Board of Underwriters, Mr. Hastings of the Edison Electric Light company, Col. Parker of the Boston Common Council, Mayor Newhall of Lynn, Mass., and P. H. Alexander of the Sawyer-Man company, expressed their approval of the steps that were being taken to insure fire-proof insulation and expressed their belief in the work of the Conduit company thus far. Mr. Johnson while in Chicago last week expressed himself as thoroughly convinced of the appreciation of the electric light companies, as it would insure them against liability from fire etc. He believes the prospects of the company excellent.

Electric Patents.

Issued February 11 *and* 15, 1890.

420,936 Electric Body-Battery. Oliver S. Hall, Marion, Iowa.

420,954. Electro-Mechanical Movement. Samuel E. Nutting, Chicago, Ill.

The object of the invention is to make an electro-mechanical movement that will be proportioned at all times and under all circumstances to the quantity of the electric current, varying with every variation in the quantity of such current.

420,955. Electro-Mechanical Movement. Samuel E. Nutting, Chicago, Ill.

420,964. Electric Vote Indicator and Recorder for Legislative Bodies. William H. Robinson, Rochester, N. Y.

The sixth claim is given:

"A record-sheet for an electro-chemical recorder having a series of names printed thereon, and provided with spaces opposite said names, said spaces being saturated with a material which will discolor under electric transmission."

420,975. Storage Battery. Charles Sorley, New York, N. Y.

420,984. Lightning-Arrester. George G. Bayne, Fremont, Neb.

421,006. Telephone Transmitter and Receiver. Hosea W. Libby, Boston, Mass.

421,011. Attachment for Telephones. George F. Newland, Detroit, Mich.

421,043. Regulator for Dynamos. Edward Heymann and Frank W. Heymann, Boston, Mass,

421,053. Thermo-Electric Resistance Regulator. Samuel E. Nutting, Chicago, Ill.

Claim four reads as follows:

'The combination of an electric circuit, a spring coilable or uncoilable by the agency of heat, a resistance coil, and a current conductor connected to the spring and conveying a current of electricity to the resistance coil and moved to different positions on the coil as the spring is coiled or uncoiled."

421,067. Art of Making Cores for Electro-Magnets. Stanley C. C. Currie, Philadelphia, Pa.

421,081. Galvanic Battery. Jacob F. Mehren, Chicago, Ill.

421,088. Conduit for Electric Cables. William P. Tyler, Boston, Mass.

421,090. Starting Switch for Electric Motors. William A. Anthony, Manchester, Conn.

421,114. Switch-Board. William M. Stewart, Schenectady, N. Y.

421,169. Electric Battery. Ernest M. G. Hewett, Newton, Mass.

421,177. Safety Device for Electric Circuits. Hermann Lemp, Lynn, Mass.

421,179. Cut-Out. Everett W. Little, New York, N. Y.

421,180. Thermal Cut-Out. Everett W. Little, New York, N. Y.

The invention consists, essentially, of a block of insulating material, into the ends of which conductors project and are secured, the block being provided with a spiral groove on its surface, in which is placed the fusing strip connected in a peculiar manner from one conductor to the other.

421,185. Electric Soldering-Iron. Willard M. Miner, Plainfield, N. J.

421,193. Transmission of Power by Electricity. Edwin W. Rice, Jr., Lynn, Mass.

Of the ten claims the second is given:

"The combination, with an alternating current electric motor having its armature supplied from an alternating current circuit, of a continuous or direct current electric motor having its armature on the same shaft with the armature of said alternating current motor."

421,195. Motor for Electric Regulating Apparatus. Friedrich Ross and Asmus Franzen, Vienna, Austria-Hungary.

421,207. Cut-Out for Incandescent Lamps. Elihu Thomson, Lynn, Mass.

421,208. System of Distribution for Alternating Currents, Elihu Thomson, Lynn, Mass.

Claim one reads:

"The combination, with the same constant potential source, of a transformer whose secondary supplies a constant current circuit having electric lamps or other final energy users in series thereon, and a transformer whose secondary supplies translating devices arranged in multiple arc, the primaries of both said transformers being supplied in multiple from the said source."

421,214. Telegraphic Sounder. George W. White, Huntsville, Ala.

421,222. Commutator for Dynamos, Motors, etc. George H. Alton and William O. Wakefield, Lynn, Mass.

The first claim is given:

"In a commutator, a segment or plate having a double bevel at its end, in combination with independent clamping-seats or bearings engaging, respectively, with the two inclines of said bevel."

421,239. Railway Electric Signal. Paul D. Cable, St. Louis, Mo.

Claim six reads as follows:

"In a signal for railways, the combination, with a suitable circuit, including a distant signal and a local relay, of a second circuit controlling said signal-circuit and having a suitable relay and torpedo-signal whose circuit is controlled by the above said relays, whereby it will only be operated by a succeeding train after the train has passed."

421,240. Thermal Cut-Out. Philip Cardew, Chatham, County of Kent, assignor to Bernard Mervyn Drake and John Marshall Gorham, Westminster, England.

421,294. Electrical Spray and Vapor Bath. Nathaniel Lyke, Williamsport, Pa.

421,304. Trolley for Electric Railways. Frank B. Rae, Detroit, Mich.

421,305. Overhead Trolley for Electric Railways. Frank B. Rae, Detroit, Mich.

421,320 Collecting-Contact for Electric Machines. Albert Schmid and Edward C. Means, Allegheny, Pa.

The invention consists in applying a flexible contact band composed of a woven wire or "linked belt" to the conductor or collector plates.

421,339. Door-Alarm. John F. Wollensak, Chicago, Ill.

The object of the invention is to close the electric circuit connecting with an alarm door-bell and cut off the same automatically as the door is opened or closed.

421,340. Electric Compound Push. John F. Wollensak, Chicago, Ill

The first claim follows:

"In electric pushes, the combination of a plate of insulating material, binding-screws for holding the ends of the circuit-wires arranged on the front of the plate, and a face having buttons and springs holding the buttons in place and adapted to be pressed into position by the buttons to complete the circuit, and a frame surrounding the plate and holding the face the proper distance from the plate."

421,371. Electrical Communication. James L. Cutler, Piketon.

The invention relates to the art of electrical communication by means of a series of signals or other devices connected with and operated from a central station; and its object is to provide mechanism whereby each of a series of visual, palpable, or audible signals at various points on a main circuit may be operated or called into action, or other work performed from a central station without operating or calling into action the signals or performing the work at other points or stations on the same circuit.

421,394. Railway Telegraph. James S. Foley, Toronto, Ontario, Canada.

421,396. Cut-out. Gustav A Frei, Boston, Mass.

421,398. Conduit for Electric Railways. Patrick H. Griffin, Buffalo, N. Y.

The invention consists in a metallic conduit for electrical conductors, having an inner lining composed of silicate of soda and sand attached to the inner surface of the metallic body by means of prongs on said inner surface.

421,439. Annunciator Thomas H. Shipway and James R. Dowdell, Toronto, Ontario, Canada.

421,449. Electro-Magnetic Valve-Controller. John V. Stout, Easton, Pa.

The apparatus embodying the invention is primarily designed for the automatic regulation or control of temperature in buildings or apartments, but may be advantageously employed to regulate or control a valve or like device in other connections, either in response to the action of a thermostat or upon the completion of the necessary electric circuit by a manually operated switch.

421,457. Electric Belt. Merian Wadleigh, Kansas City, Mo.

The invention consists in the combination, with an electric railway car or vehicle, an electric motor carried thereby, and a main conductor exterior to the car, of one or more lamps connected in series circuits with the main conductor and the motor, and a storage battery carried by the car and having one pole connected to the main conductor, to be charged thereby, and its other pole connected with the motor, the circuit of the said lamps being in multiple arc with the said storage battery charged by a current from the main conductor, and an electro-magnet connected to the storage battery, and controlling a switch in the motor circuit.

421,464. Electric Railway Car. Robert C. Wirt, Boston, Mass.

421,469. Arc Light Carbon. Walter E. Adeney and Llewellyn Saunderson, Kingstown, County of Dublin, Ireland.

The first of the four claims is as follows:

"1. The method of manufacturing electric arc carbons, which consists in mixing together powdered gas coke, powdered coal, and an infusible or difficultly fusible material, inserting the mixture in a mold, heating it under mechanical pressure, removing the carbon pencil thus formed, immersing it in hot coal tar, and heating it, then taking it from the coal tar and cleaning its surface, and again introducing it into a mold and heating it under mechanical pressure."

421,473. Gas Engine. Harrison J. Baker, Chicago, Ill.

421,479. Dynamo-Electric Machine. DeWitt B Brace, Lincoln, Neb.

The object of the invention is to obviate the necessity of rotating either the field magnets or armature proper, and also of thus obviating in certain classes of machines both commutators and brushes.

The second claim is appended:

"The combination with fixed field magnets wound with magnetizing coils having two or more opposing pairs of fixed laminated polar projections wound, one or more, with armature coils, of laminated magnetizable masses moving in a plane perpendicular to the magnetic force between the opposing laminated poles and successively closing the magnetic circuit between successive pairs of poles."

421,484. Camera and Electrical Flash Light Attachment. George E. Davis, Dubuque, Iowa.

421,498. Apparatus for Heating Water and Generating Steam by Electricity. John C. Hubinger, Keokuk, Iowa.

The object of the invention is to heat water held or contained in vessels and to generate the steam therefrom by the introduction and transmission of one or more currents of electricity into and through greater or less portions, columns, or sections of water to be heated, causing currents in the water in consequence of the colder portions rising to fill the place of the warmer, so that the entire mass of the water is brought within the influence of electrical current and is rapidly and uniformly heated and steam generated therefrom

421,499. Art of Heating Water and Generating Steam by Electricity. John C. Hubioger, Keokuk, Iowa.

421,508. Electrical Annunciator. Albert F. Parks, Troy, N. Y.

421,530. Time Alarm. George A Straight, Kingston, Rhode Island.

421,535. Switch for Systems of Electric Locomotion. Frank Wheeler, Meriden, Conn.

421,567. Electric Lock William Grah, Jr. Toledo, Ohio.

The invention relates to locks, and has reference to that class in which the nose-piece of the sliding ball is pivoted and adapted to swing backward.

421,586. Incandescent Lamp Socket. William P. Kookegey, Brooklyn, N. Y.

421,594. Mining Machine. Moses A. Michales, Allegheny, Pa.

421,630. Electric Lamp Adapter. James Stewart, New York, N. Y.

421,636. Telephone Switch. Erastus C Titus, Catskill, N. Y.

421,654. Machine for Turning Telegraph Pins. William W. McNeal, Stockton, N. J.

421,666. Electrode for Secondary Batteries. Hiram H Carpenter, New York, N Y.

The invention relates to an improvement in the art of making secondary battery electrodes which consists in forming a thin strong casing or support for the active material by submitting metal in a suitable mold to a heavy pressure, whereby a casing or support of great density and durability is obtained.

Claim two reads:

"In secondary or electric storage batteries, an external case of inactive maiter having an insulating and acid-resisting coating applied to its surface."

421,677. Support for Trolley Wires. John H. Cunningham, Chelsea, Mass.

421,733. Carbon for Arc Lamps. Edward L. Liedke, Sandusky, Ohio.

421,781. Electric Conductor. John A. Stoughton, East Hartford, Conn.

This invention consists of a metallic wire in combination with a series of mutually-articulated glass cylinders, in closing the same.

421,790. Electric Motor. Philip B. Walsh, Philadelphia, Pa.

421,791. Electric Railway Signal. Willie C. Walter, Richmond, Va.

421,800. Mouth-Piece for Telephones. Ruel W. Whitney and Byron K. Cowles, San Francisco, Cal.

421,801. Electric Battery. Charles Willms and Gustav A. Liebig, Jr., Baltimore, Md.

421,802. Flexible Electric Connection. John F. Wollensak, Chicago, Ill.

421,819. Insulator. John W. Davy, Pittsburg, Pa.

421,851. Electrical Indicator. Leo Bock, Jr., New York, N. Y.

The invention is designed to indicate in the office of the building superintendent, the running and position of the elevator in its shaft.

421,852. Thermostat. George F. Bulen, Tompkinsville, N. Y.

421,853. Automatic Fire-Alarm System. George F. Bulen, Tompkinsville, N. Y.

421,854. Automatic Fire-Alarm Transmitter. George F. Bulen, Tompkinsville, N. Y.

421,864. Hanging Device for Electric Lamps. William H. Layng, New York, N. Y.

421,882. Visual Annunciator for Call-Boxes. Paul Seiler, San Francisco, Cal.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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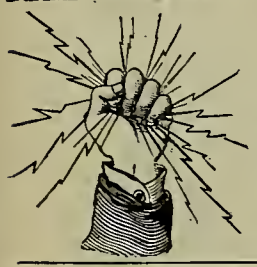

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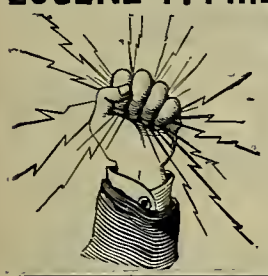

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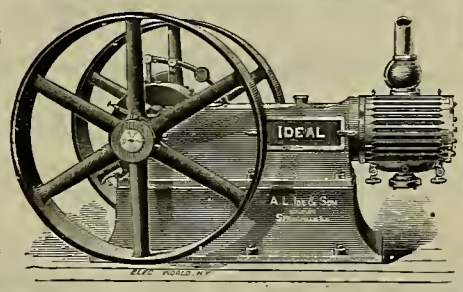

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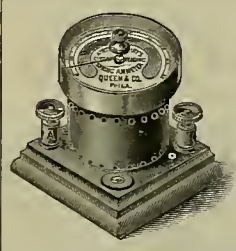

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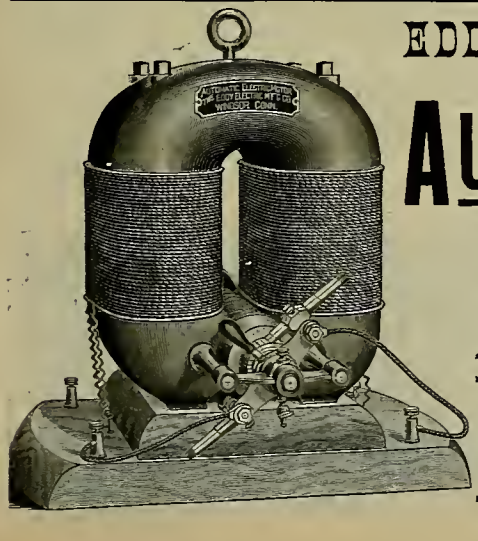

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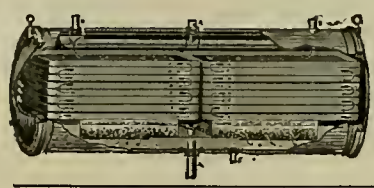

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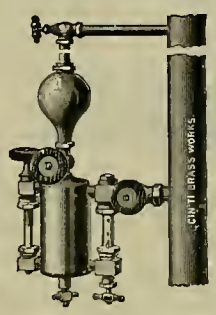

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The North American Review.

OTHER FEATURES OF THIS NUMBER ARE:

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STATE RIGHTS. By Jefferson Davis.
NEWSPAPERS HERE AND ABROAD. By E. L. Godkin.
BRITISH CAPITAL AND AMERICAN INDUSTRIES. By Erastus Wiman
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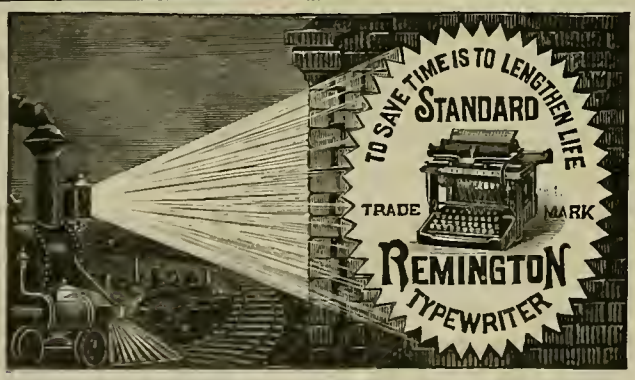

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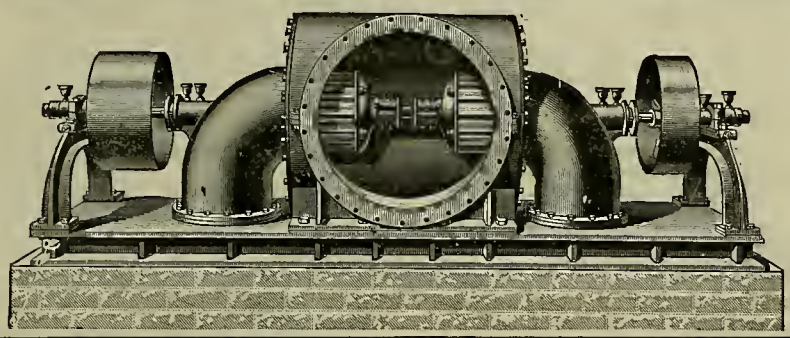

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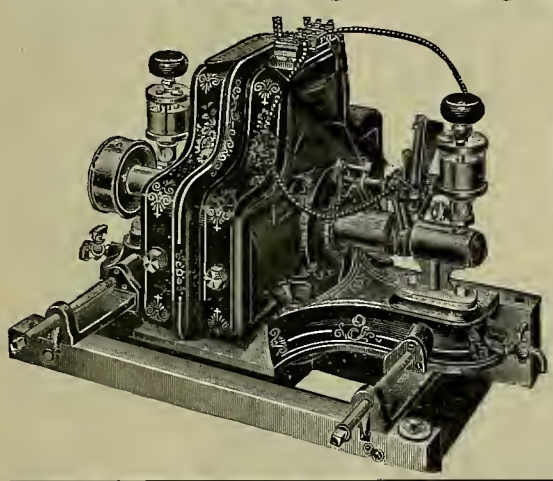

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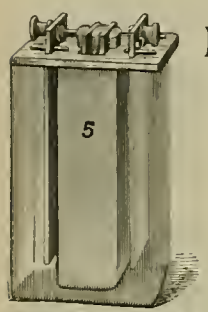

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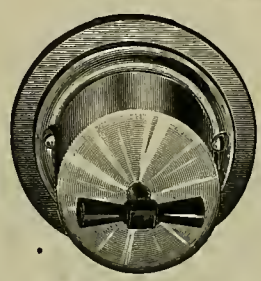

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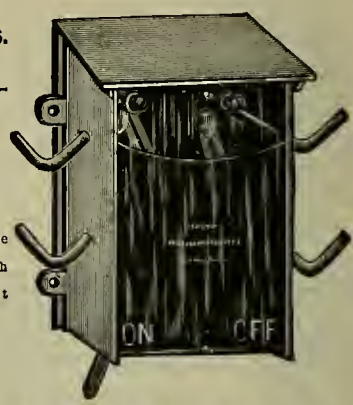

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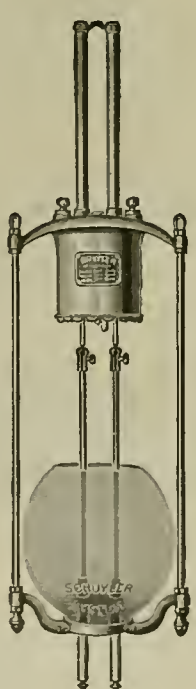

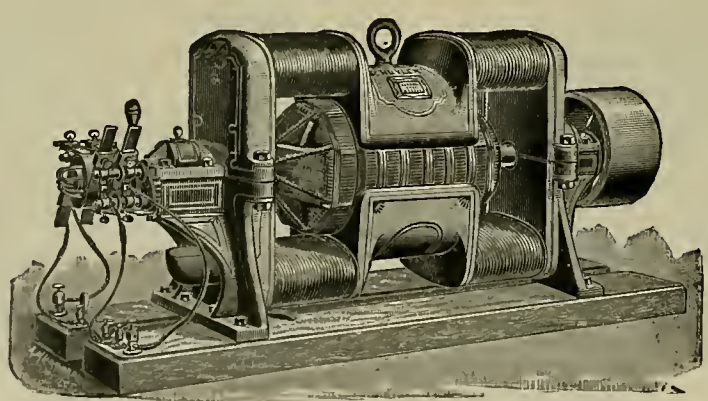

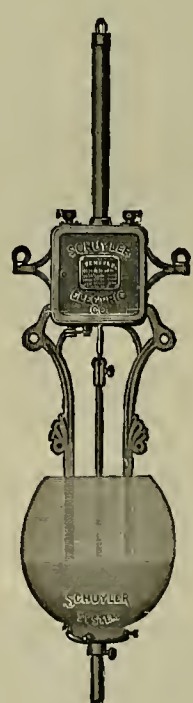

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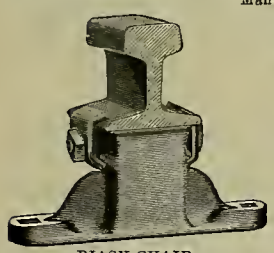
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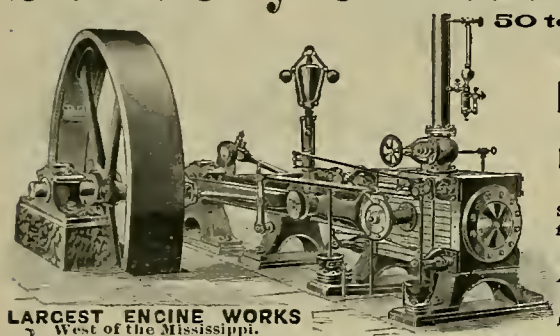

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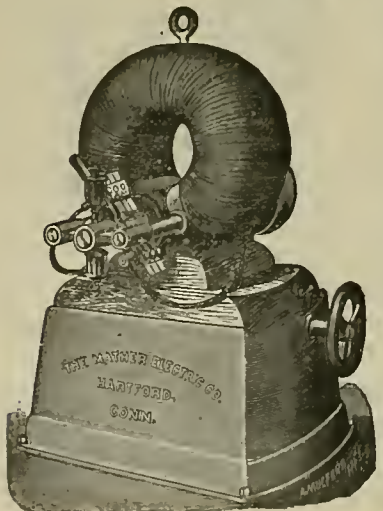

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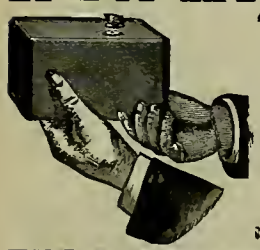

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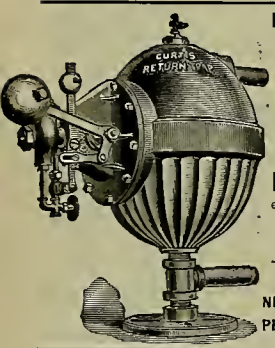

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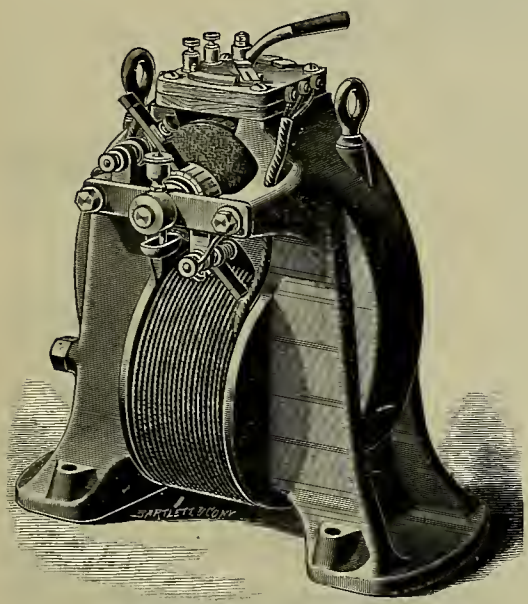

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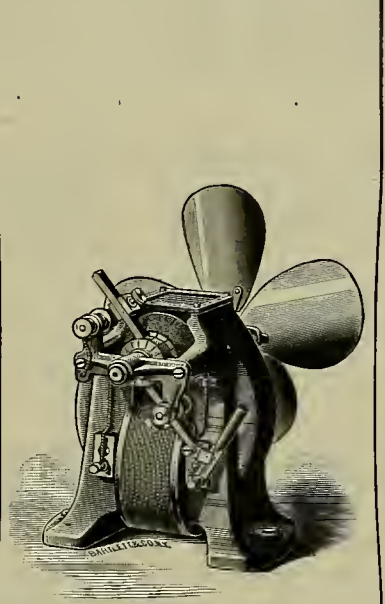

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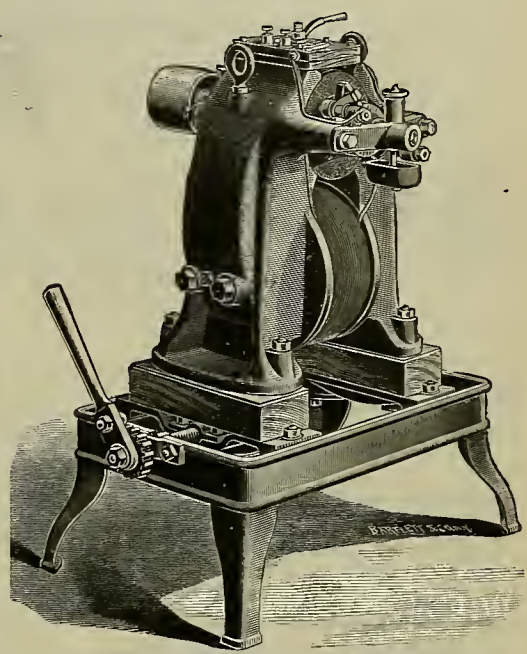

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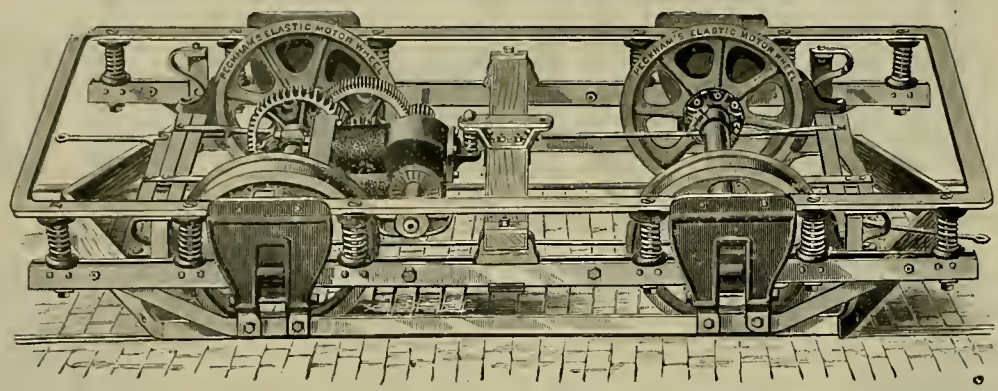

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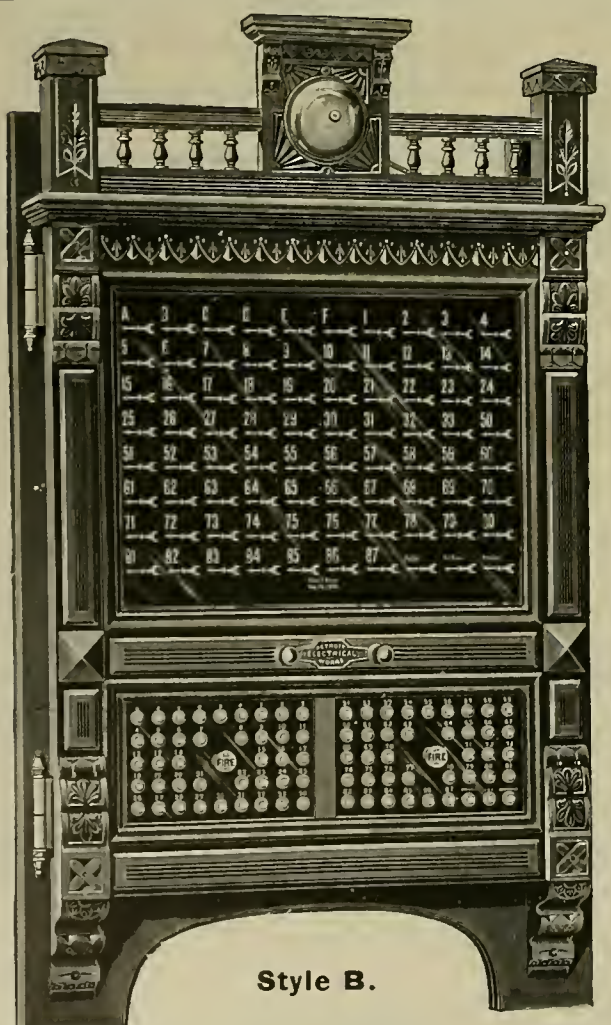

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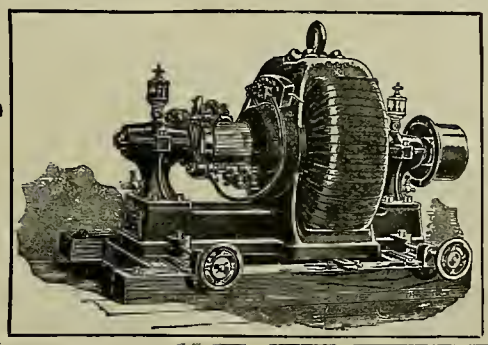

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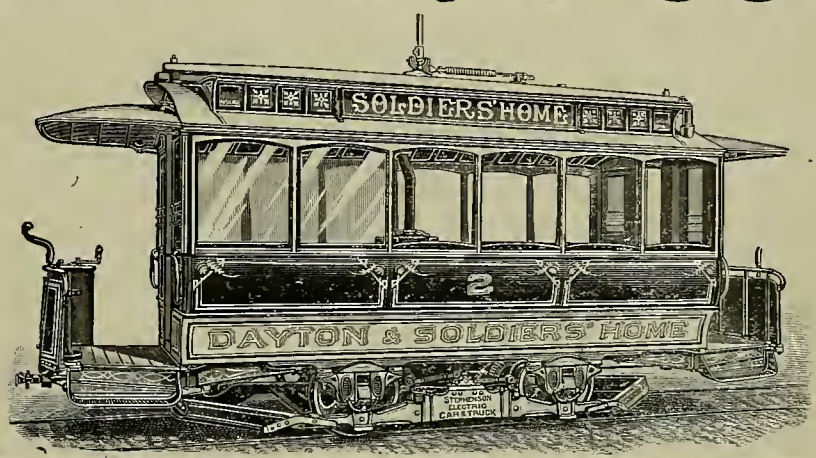

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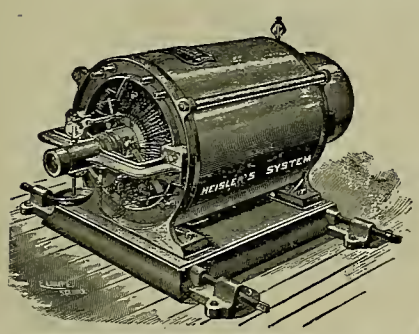

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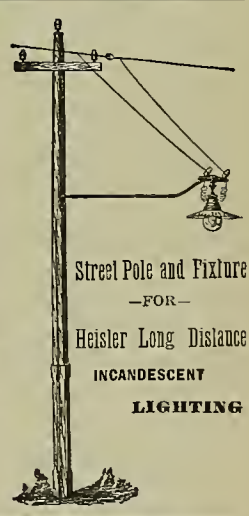

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The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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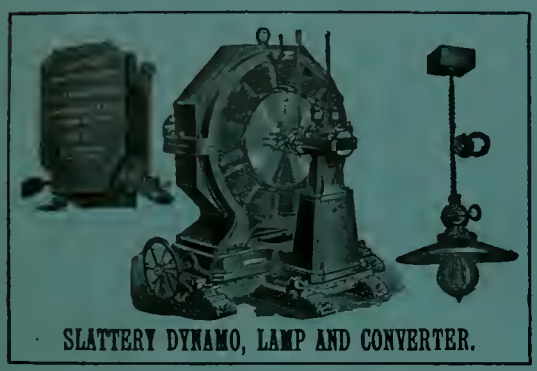

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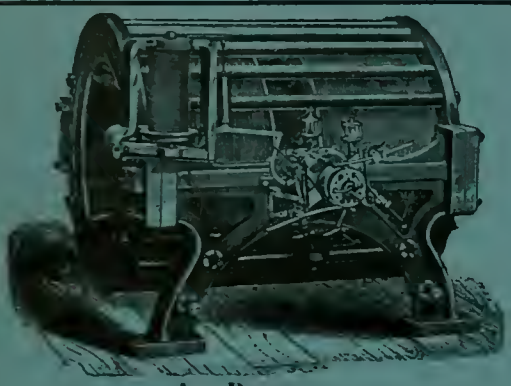

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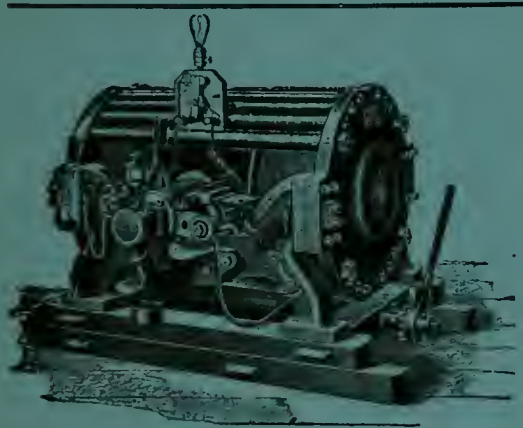

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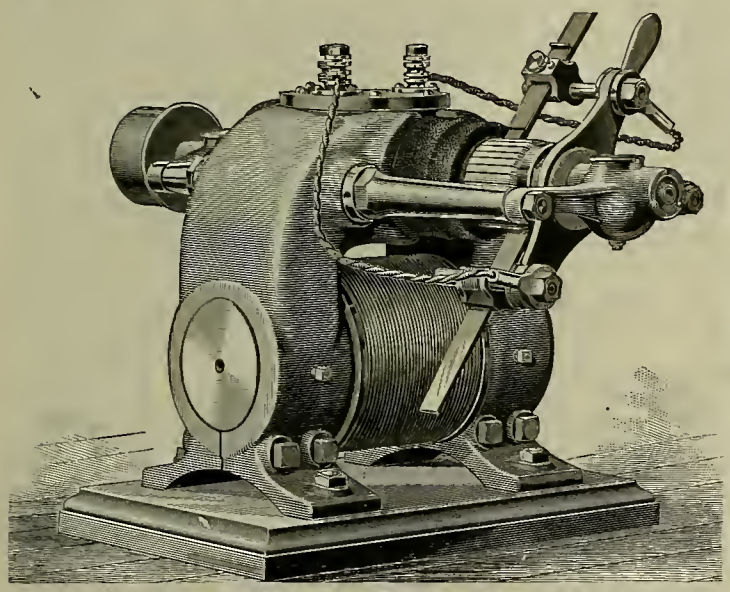

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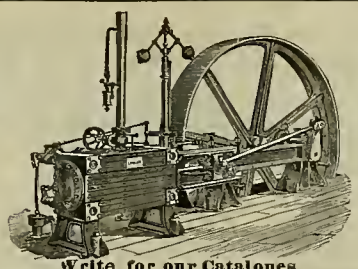

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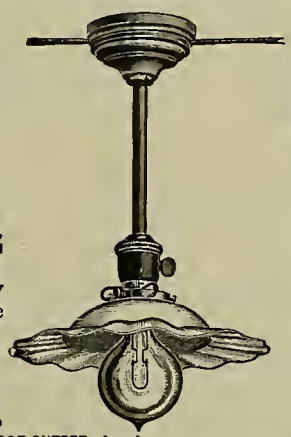

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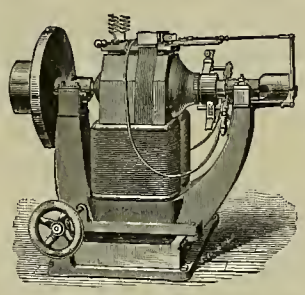

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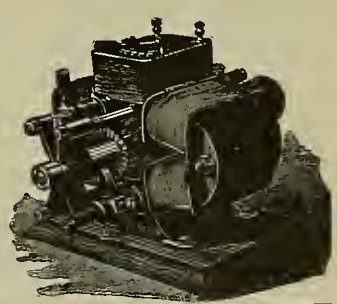

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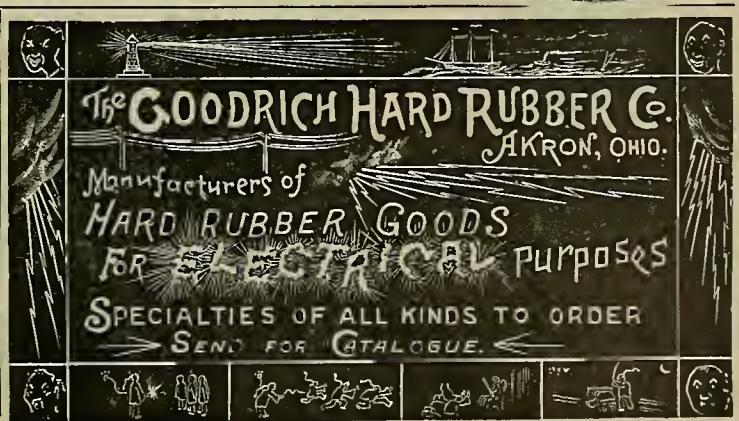

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We are exclusive Western Agents for all of the Brady appliances, which have been so universally adopted in electric light construction throughout the country.

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THE WALTER K. FREEMAN
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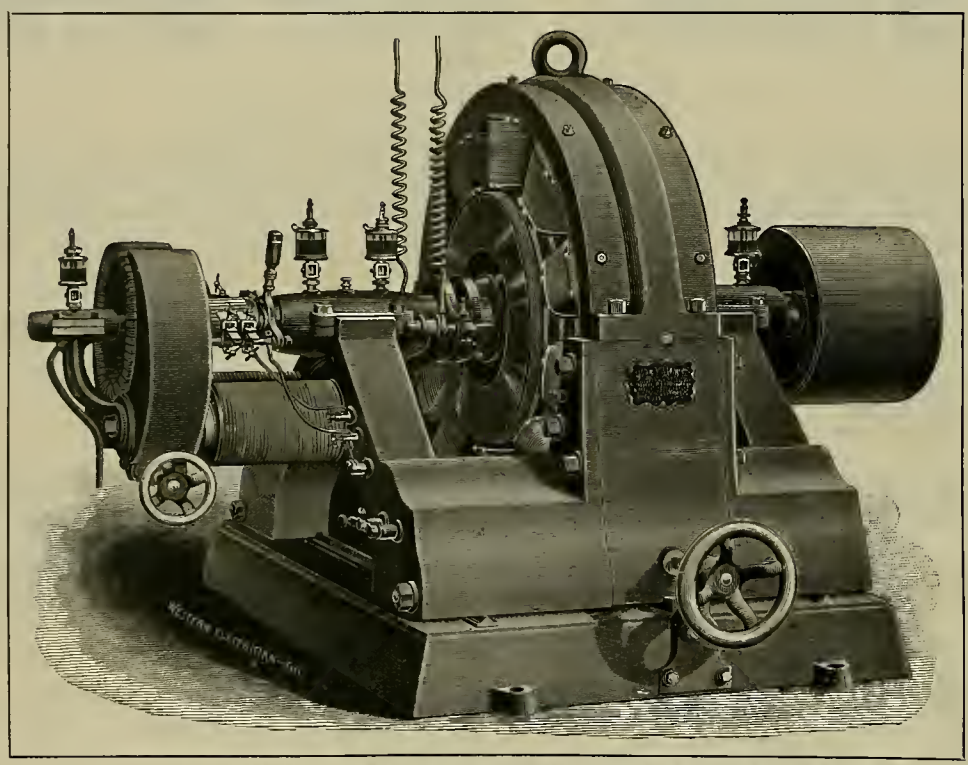

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Incandescent Lamps and General Electrical Supplies.

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All systems having the main wires connected directly with wires on premises are dangerous.

With an alternating system, the lighting may be done without any electrical connection between the house wires and the main wires. A converter in an alternating system separates the mains from the house wires and constitutes an impassable barrier between the current in the high tension street wires and that used for lighting the lamps in the houses.

A perfect converter requires two coils separately wound, separately insulated, and separated from each other and the core. The converter of The Westinghouse Electric Company is the only device which fills this requirement.

A converter not only separates the street mains from the house wires, but it limits the quantity of current that can be transferred from the street mains to the house.

In an experience of 265 central stations, employing 25,000 converters, there has been no case in which any connection has been established between the current carried on the street mains and the wires in the houses, by lightning or otherwise, and there has been no case of accident to any consumer or upon the premises.

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Manufactured under Patents of Stanley, Wallace and Others.

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THREE MORE LARGE CITIES FALL INTO LINE.

All the lines in Minneapolis and St. Paul and between those two cities, comprising 200 miles of track, are to be equipped with the Sprague Electric System.

(Statement of Mr. Thos. Lowry, Prest. of the Minneapolis Street Railway.)

"NEW YORK, Feb. 19, 1890.—I have to-day closed contract with Sprague Electric Railway & Motor Co. for the Electrical Equipment of the Street Railways in Minneapolis and St. Paul, and between those two cities."

(Signed) *THOS. LOWRY, Prest.*

St. Louis follows with an order for sixty-eight car equipments for the Lindell St. Railway in that city.

Total number of Street Railway Motors contracted for since January 1, 1890.----810.

Sprague Electric Railway & Motor Co.,

16 & 18 Broad St., New York.

Rialto Building, Chicago, and all Commercial Centers.

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A New and Improved Method of Equipping Buildings with an Insulated Tube Conduit for any System of Electric Wiring.

COMBINING:

SAFETY—Absolute immunity from electric fires.
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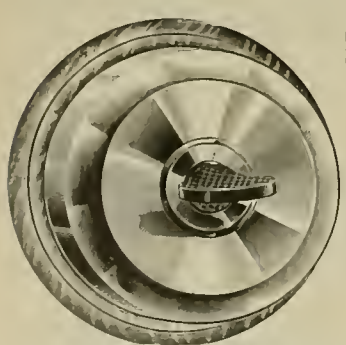

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Recognized as the best, simplest and most durable circuit breaker in existence.

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KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

USE THE BEST INSULATION.

The CELEBRATED P. & B. ELECTRICAL COMPOUNDS.

Thoroughly MOISTURE and WEATHER Proof, resist the STRONGEST ALKALIES, STRONG ACIDS, FUMES and GASES; also P. & B. WATERPROOF WRAPPING and INSULATING PAPERS.

We manufacture a special VARNISH for ARMATURES, and FIELD COILS.

The Standard Paint Co., 59 Maiden Lane, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. V. CHICAGO, MARCH 8, 1890. No. 10

Testing and Cable Rooms in the Western Electric Company's Factory.

The accompanying cuts give two interior views of the Western Electric company's factory in Chicago. Fig. 1 illustrates the lamp testing room. As will be seen, the lamps are arranged in rows on racks and each group can be separated from the others when desired, by dropping curtains provided for this purpose. This is desirable at tmes when large numbers of lamps are being tested as the glare from one set often interferes with men engaged on another set. This will be appreciated when it is mentioned that there are facilities for testing 150 lamps at one time in this room. Wires reach the lamp testing rack in lead-covered cables, and circuits are arranged with a double pole cut-out for each lamp.

Fig. 2 shows one side of the cable room in which the core is pulled into the lead pipe in the manufacture of Patterson cable. The lead pipe is made in lengths of about 100 feet, while the cable core is made in any desired length, and then pulled through the necessary number of sections of lead pipe to make up the desired length, the ends of the lead pipe being afterward joined with a plumber's wiped joint. The cable is subsequently filled with paraffine wax under pressure.

FIG. 1.—TESTING ROOM IN THE WESTERN ELECTRIC COMPANY'S FACTORY.

Double Carbon Lamp Litigation.

The recent decision of Judge Gresham in the case of the Brush company against the Fort Wayne, Ind., Electric Light Co., in which the patent number 219,208, granted to Charles F. Brush Sept. 2, 1879, for improvements on double carbon arc lamps was sustained, has led the Brush company to follow up the advantage thus gained, and institute similar actions against other companies which it claims infringe the patent.

Judge Jackson of Toledo, O., has a case before him which it is expected will soon be decided. The Brush company has instituted an action for an injunction and damages against a local company using the Western Electric company's apparatus.

Two actions have been commenced by the Brush company against the Sperry company of Chicago and the Belvidere, Ill., Electric Lighting company and others. In both actions the Brush company seeks an injunction and asks for damages. The Belvidere company is using the old style of the Sperry lamp. Both actions will be submitted to Judge Gresham April 2. An order was entered Monday directing the Sperry and Belvidere companies to file their answers on or before March 19th and the Brush company to make its reply March 31st. The cases will receive considerable attention from all who are interested in electric lighting.

Storage Batteries in Car Lighting.

A chair car attached to a Union Pacific train was so brilliantly illuminated by electric lights that it attracted considerable attention in Chicago last week, as it stood in the Northwestern train house. Current was supplied from Carpenter storage batteries manufactured at Denver. It is claimed by the projectors of the system that they will supply current for thirty consecutive hours. There were ten incandescent lamps in the car. The Union Pacific and Northwestern will experiment with the batteries. The result of these tests will be awaited with considerable interest in railroad and electrical circles.

Married by Telephone.

The telephone had been used for almost every conceivable object, it was thought, but it remained for a couple of Indiana operators to discover another application, much to their sorrow. The night operator of the South Bend exchange is described as a very pretty young girl of 22 years, but whether she is or not, it is certain that she proved a very entertaining companion, over the wire, for the impressionable young man who held a similar position at Mich-

igan City. Last week the young man proposed a mock marriage and the young lady readily assented. A justice of the peace was taken into the deal, and when the legal formality had been observed, the questions asked and answered, the young lady at South Bend and the young man at Michigan City were pronounced man and wife—and so they were, as it afterward proved, according to the laws of the state of Indiana. For a time the couple did not realize the position they had placed themselves in, but some of their friends learning of the proceedings, consulted the best legal authority in the state it is alleged, and it was agreed that the marriage would stand.

Here, then, was a nice state of affairs. The bride and groom had never met and they knew nothing of each other excepting that they had exchanged everyday greetings and commonplaces over the wire. But this was not all. The young man was engaged to be married and the arrangements for the wedding were completed—the ceremony being fixed for some time next month. The young man immediately arranged for a vacation and decided to visit South Bend, but not to greet his bride with outstretched arms. Far from it, his pilgrimage to the home of his bride was anything but a mission of love. He will endeavor to secure a separation and marry the girl to whom he is engaged, provided of course, she will take him second hand.

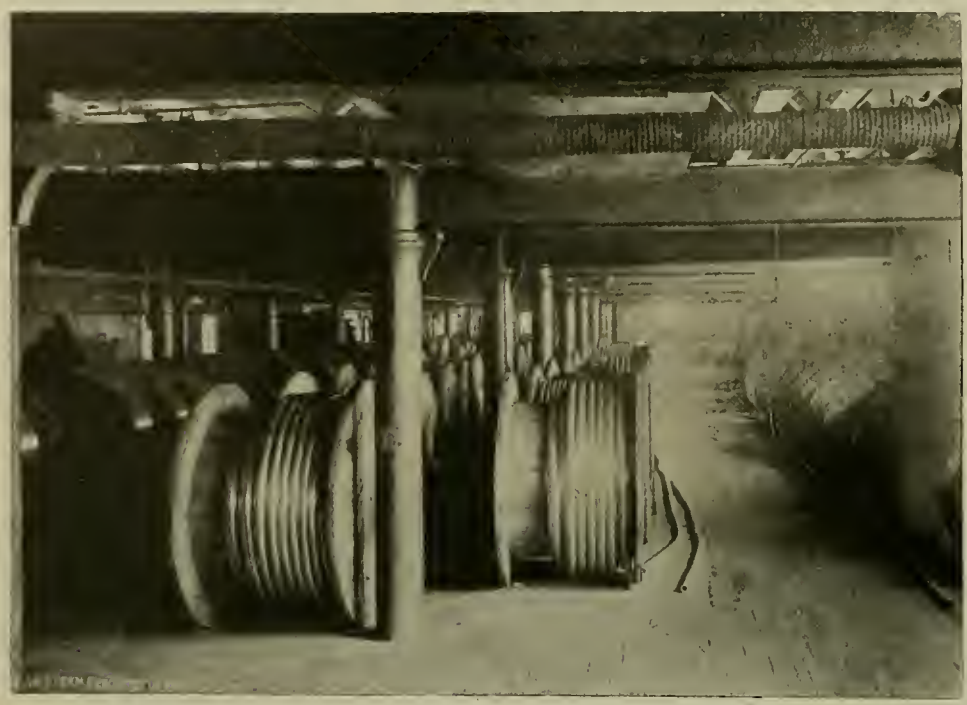


FIG. 2.—CABLE ROOM IN THE WESTERN ELECTRIC COMPANY'S FACTORY.

Electric Transfer Table.

An electric transfer table, recently installed by the Sprague Electric Railway & Motor company for the New York Central & Hudson River railroad, is shown in the accompanying cut. This table differs from earlier ones, chiefly in the electric motor, which is of 15 horse power instead of 7½ horse power, and also in the contact arrangement. The contact is obtained from a couple of heavy copper wires stretched out about 3 feet apart over the second of the four parallel tracks. The wires are carried on insulators fixed to light cast iron cross beams, so as to be a few inches above the rails. The conductors are kept taut under all changes of temperature by springs at one end. Over these wires two contact rollers travel beneath the tables, being kept in contact by gravity only. In the Aurora electric transfer table installed by the Sprague company for the C. B. & Q. railroad, there is an under contact maintained by springs, while at the Waukesha electric transfer table, installed by the Sprague company for the Wisconsin Central Railroad company, there is an overhead contact. The current used is 220 volts. The current is taken from the same dynamo that furnishes light for the station. The full current capacity of the table motor is 60 amperes.

The speed of the electric motor is governed by a switch which throws the winding of the field into different combinations By this arrangement the motor is worked without the use of any external resistance. The control over the speed of the motor is perfect, and no complicated gearing for changing speed is required.

The motor is supported at one end according to the regular Sprague method by double compression springs playing upon a bolt which rests upon the platform of the transfer table. This method has been developed in street railway work and other places where it is desirable to start slowly under a heavy load, and has proved very satisfactory. On the other end the motor is sleeved on a rigid support. By means of this flexible attachment, all danger of stripping the gears is eliminated, and the strain upon the gears is always progressive.

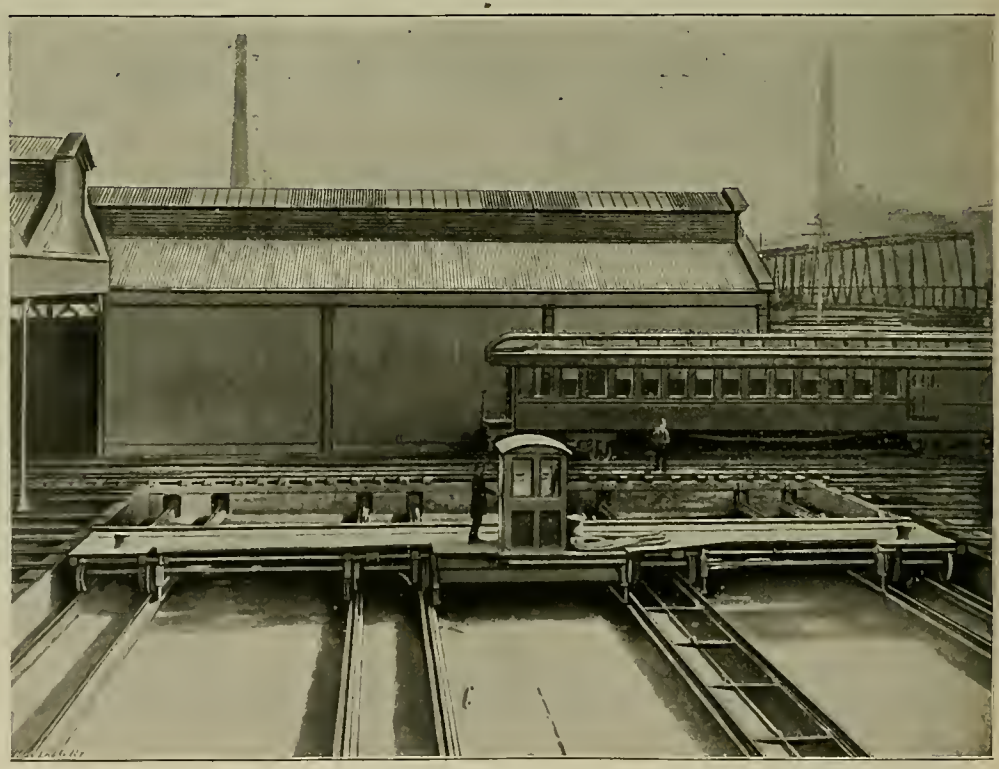
The advantages of electric power for this work are claimed to be great. The equipment is very much lighter than if steam power were used, and there is no expense of operation when the table is not in use. One man can easily handle the table, and more conveniently and directly than with steam.

The two end capstans shown on the table are fixed; the center one is revolved in either direction, by a simple clutch gear. It is used, of course, for working cars on or off the table without locomotive power.

The capacity of the table is 100,000 lbs. Ordinary car axles, bearings and wheels are used throughout for the running gear. Its speed is about 150 feet per minute, the same as the old wire rope table which it replaces. The old pit was lengthened somewhat, and accommodates ten tracks. The rails are carried on wooden longitudinals resting on small masonry foundation walls. The pit drains directly into the city sewers.

The table is constructed with 15 inch cross beams and 12 inch longitudinals, thoroughly braced with a rigid iron lateral system. It was designed and built by the Yale & Towne Manufacturing company of Stamford, Conn.

The small cabin, shown at the center of the table, is provided for the operator. Electric transfer tables have now been adopted by the Pennsylvania Railroad company, Philadelphia & Reading Railroad company, Chicago, Burlington & Quincy Railway company, Wisconsin Central Railroad company, and other corporations, and they are now recognized as an essential feature of every extensive and well-equipped railway switch yard.



ELECTRIC TRANSFER TABLE.

New York Electric Club.

The members of the New York Electric Club listened to an exhaustive paper on "Patent Law and What Constitutes an Invention," by Grosvenor P. Lowrey, February 20. The introduction of the first British patent act in parliament was opposed by many so called philosophers, the speaker said, on the ground that it would prove detrimental to the progress of art and manufactures, and even in this enlightened age representatives in congress of rural districts are always ready to support a movement against patent laws. The manifold benefits which they reap are lost sight of; they forget that the protection afforded inventors in their discoveries has made vast improvements in the condition of the farmers; that the patent law enables them to be western farmers instead of eastern pioneers; that it places within their reach many of the advantages of metropolitan life. In reply to the statement that inventors will continue to invent without patent law protection, and that the advantages they obtain over their competitors in business will amply repay them for their labor, attention is called to the fact that many of the great inventors were not trained or engaged in the art to which their invention relates. Watt was not a maker of steam engines; Arkwright was a barber; Cartwright was a preacher; Wheatstone was a manufacturer of musical instruments, and Bessemer was in no way connected with the steel industry. Following out this line, Mr. Lowrey says: "Let us try to conceive, now, of Bell keeping his process secret, or Edison hiding his light under a bushel! How could Bessemer have reaped the reward due to the great economy in fuel

and capacity for high heat which his generative furnace introduced except by patent protection? Should he have taken up the working of it? The universality of its application makes that impossible. His furnaces are in use for the making of wrought iron, of steel, of plate and flint glass, for copper melting, and for a great many other industrial objects requiring furnace power. In short, the suggestion shows ignorance of the inventor's practical needs during the growth of his invention, and of the kind of security he must give to capital to obtain it. The last report of the Edison General Electric company states that their patent rights show a cost of $1,032,010.17. Imagine Edison in 1879 going to even the richest man in the world and saying: 'I think, but am not sure, that I can invent what is necessary for a new system of domestic lighting. If we succeed, it will be necessary that you should first lay out $——, and wait for a dividend of 2 per cent. until December, 1889. And your getting even that return of your capital will depend upon our being able to keep the art a secret while going into the business of supplying electric light ourselves in competition with the great and powerful gas industry. If I fail, your money will be all lost.'"

If any further justification were needed, the experience of Crompton, who endeavored to keep his discoveries secret, would clearly demonstrate the necessity of protecting inventors in the enjoyment of the benefits of their improvements. Mr. Lowrey reviewed the patent laws of foreign countries as well as the United States, and instituted instructive comparisons. The discussion which followed the reading of the paper was also interesting. Before the meeting adjourned the following resolution was adopted:

Resolved, That the Electric club of New York is in hearty sympathy with the effort of American authors, publishers, employing printers and workmen in the printing trades to obtain from congress a just recognition of the rights of intellectual property, and we hail with satisfaction the prospect of an early passage of the International Copyright Bill.

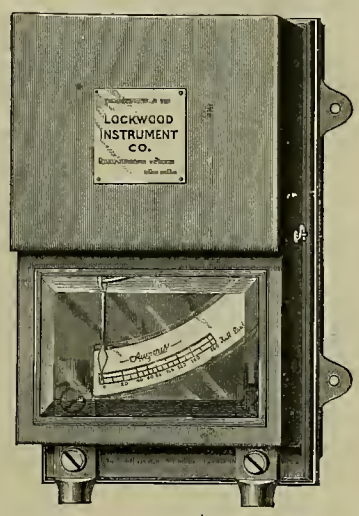
Death of Charles L. Mitchell.

Charles L. Mitchell who died last Saturday was at the head of the firm of Mitchell, Vance & Co., New York. He was born at New Haven, Conn., August 6, 1844, and received his education at Yale. He was interested in many enterprises and took an active part in all public movements. He represented his district in the Forty-eighth and Forty-ninth Congress and took an active part in the proceedings of the house, acting as chairman of the committee on patents. His wife and son survive him.

Rae Horn Measuring Instrument.

In electric measuring instruments it is of first importance that the controlling force should not be liable to changes, due to variations of temperature, position, etc. It is a well known fact that no controlling force is so suitable in this respect as that of gravity. The most serious objection to its adoption, however, has been the difficulty in making the deflecting force increase proportionally with that exerted by gravity, which increases rapidly as the pointer and armature leave their vertical or zero position. It is therefore evident that, in order to obtain an even scale, the force exerted by the current to be measured must keep pace with the increasing action of gravity. This can be accomplished in either of two ways, or by a combination of both. In the first, the armature is so situated or shaped as to move into an increasing field of force due to its situation or shape, in relation to such field; in the second, by suitably proportioning the mass of iron to the magnetizing current, the magnetization being made to increase more rapidly than the current.

A brief description of the instrument shown in the cut, invented by Frank B. Rae, will show that he accomplishes the result by a combination of these conditions. In this instrument he has a tapered, well annealed, iron core of relatively large dimensions, bent so as to be concentric with the arc of the swing of the armature. The upper portion of this tapered "horn," is wound with wire to carry the measured current; the lower portion protrudes from windings and tapers down to a cross-section, considerably less than that inclosed by the helix. To the upper pole of the horn and against the cheek of the windings is fixed a bearing, also of soft iron, from which is freely suspended a rod of iron; the rod is attached at the lower end to an iron ring, the inside diameter of which is such as to allow it to have about one-eighth inch clearance, when at the largest part of the horn. To the lower edge of this ring is fastened rigidly a light pointer which passes in front of a scale upon which are marked the values of current in amperes. When this ring armature is in its zero position it hangs vertically and just incloses the tips of the horn. It will be readily understood that on the passage of a current, a certain degree of magnetization is imparted to the tapered horn so that a pole is formed at its end, opposing the ring where an opposite pole is induced. Since there is a complete magnetic circuit, broken only by the space between the ring and the tips of the horn, the ring will be deflected and tend to creep up the horn in order to shorten the magnetic circuit. This it does until the magnetizing force is balanced by the pull of gravity. These instruments are practically dead beat, are reliable and strongly made. It is practically impossible for them to get out of order. They are made in sizes from 60 amperes

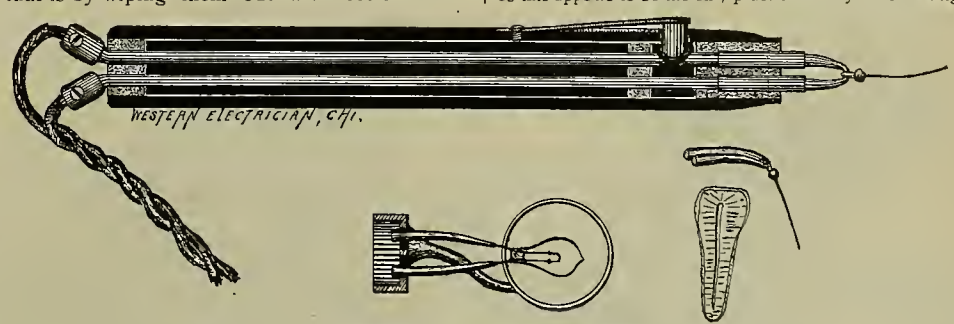


RAE HORN MEASURING INSTRUMENT.

reading, to 400 amperes, they are placed in hardwood cases, with beveled glass fronts, and all the metal parts are highly polished and handsomely plated. They are manufactured by the Lockwood Instrument company of Detroit.

Gilmer's Electric Root Canal Drier.

One of the difficulties experienced by dentists is the drying of the root canals of teeth in which the pulps have been destroyed. To treat successfully such teeth necessitates the removal from the canals of all dead pulp and moisture. The canals being very minute as shown in the cut, it is almost impossible in many cases to perfectly cleanse them by the ordinary method, that is by wiping them out with cotton fibers



GILMORE'S ELECTRIC ROOT CANAL DRIER.

wound on a jeweler's broach. To heat and apply a broach and dry the canal by this means, is also unsatisfactory on account of the quickness with which the tool loses its heat. The necessity for something better with which to overcome these difficulties has led to the production of the instrument which is illustrated in the accompanying cut. The body of the tool is made of hard rubber as indicated. Within this handle are set two conducting rods which are in connection with two Pumpelly storage cells. The ends of these rods are provided with sockets, into which a small platinum loop may be inserted. An inspection of the cut shows the form of this loop and also a slender platinum point, which is attached to it. As is indicated, the wire of which the little loop is made, is reduced at the bend, and at this point the slender end is attached by soldering with fine gold. In addition there is melted on the point, near the joint with the loop, a globule of gold. By this construction the heat is concentrated at the bend and in the point.

The action of the device will now be readily understood. When it is desired to dry out a canal the proper shaped loop with its attached point, is put into the socket and the platinum point inserted into the canal. It is then only necessary to close the circuit by pressing upon the button. In addition to the drying device the inventor has also designed an attachment, consisting of a small incandescent lamp and reflector. This is found quite useful and can be readily attached when desired in place of the drying point. The instrument is the invention of Dr. Thos. L. Gilmer, Chicago, and is used by him in his practice with great success.

Electric Railway Litigation.

In the legal controversy between the Hudson River Telephone company and the Watervliet Turnpike & Railway company in which the former sought to enjoin the latter from introducing an electric system of propulsion on its lines, Judge Landon of the Supreme Court of New York has handed down an interesting opinion. He finds that "by the grant of the state the plaintiff lawfully uses electricity for telephonic purposes, and the defendant lawfully uses it for railway propulsion, and each company has its respective rights and privileges along the same streets and highways." These grants, however, do not give either company exclusive domain, but on the contrary "the grant to each company is to employ upon the same street the invisible energies of nature, and since it is impossible to define the fields that confine them we are perforce constrained to seek for methods which will neutralize or reduce to a minimum the injurious effects of their contact or interference with each other." It is conceded, the court says, that the employment of a metallic circuit by one company will remove the difficulty, and "the problem seems to be which company, under the circumstances, ought to use the metallic circuit, and if the plaintiff ought to use it, ought the defendant to pay the expense thereof wholly or in part." The franchises of these companies make no provision for the method of construction, and do not give to either company the exclusive right to employ the earth for the return circuit. "The public motive inducing the respective grants was to promote the public welfare and to enlarge the public benefits to be derived from the streets. It is plain that if these grants can be so construed as to permit both companies to occupy the same streets beneficially to themselves and to the public such construction should be adopted. To accomplish this each company should adopt upon equitable terms such reasonable methods and safeguards as shall most prevent interference with the other or injury to itself. The same rule which binds them to care to avoid injury to third persons binds them as to each other. Both companies can maintain and operate their respective plants upon the same streets; each should do what is reasonably necessary to avoid interference with the other and to protect itself."

The court further finds that the single trolley system employed by the street railroad company is "the best now known, regard being had to mechanical, electrical and financial considerations." It is much cheaper to construct a metallic circuit for telephones than electric railways and as this appears to be the only practicable way of obviating the injury, the court says, the question arises whether the telephone or railway company ought to bear the expense.

This is an equity action in which upon the trial the court will have jurisdiction to administer all the relief which the nature of the case and the facts demand. Concluding the court finds: "We cannot place the burden of this expense in the first instance upon the defendant, since the plaintiff ought not to yield control of its lines to the defendant. The necessities of the case compel us to require the plaintiff to assume it in order to protect itself against the defendant."

Telegraph Tournament.

The National Fast Telegraphing Tournament will be opened at Hardman Hall, New York, April 10th, when the following conditions will be enforced:

1.—Number of words to be transmitted: From 250 to 500, according to number of entries. 2.—Speed combined with excellence. The instruments to be used will be furnished by the leading electrical manufacturers who have contributed money for prizes.

Classification.—Class A—Open for all. Class B—Open for all, barring those who have a record of better than eleven minutes on the 500 words used in the last contest.

Ladies' Class.—Free for all.

Old Timers' Class.—Open for those who were in the service prior to 1865.

Entrance fee $2, except in the ladies' class.

The transmission by each operator will be recorded with a caligraph in the hands of an expert operator, thereby illustrating the value of the writing machine worked in conjunction with the telegraph.

Under date of February 17, C. W. Summers, manager of the Western Union office at Schriever, La., addresses the manager of the Western Union Telegraph company, New York, as follows:

"I will challenge the winner of the first prize in the coming contest to be held in your city in April next, to determine the shortest time a given number of words can be telegraphed, in a like contest of 100 words for $500 a side. Same to take place at any given place and time. Please inform committee."

The Commercial Illuminating company, at Chicago, has been incorporated to furnish electric light, heat, and power; capital stock, $25,000; incorporators, C. E. Acker, R. L. Gibson, and M. B. Austin.

Power House of the Fourth Avenue Electric Railway, Minneapolis, Minn.

The accompanying cuts illustrate the power station of the Thomson-Houston electric railway in Minneapolis, Minn. This building, in which all the machinery of the Fourth avenue road is located, was formerly the property of the Pray Manufacturing company, and recently came into the possession of the Minneapolis Thomson-Houston Electric Light & Power company.

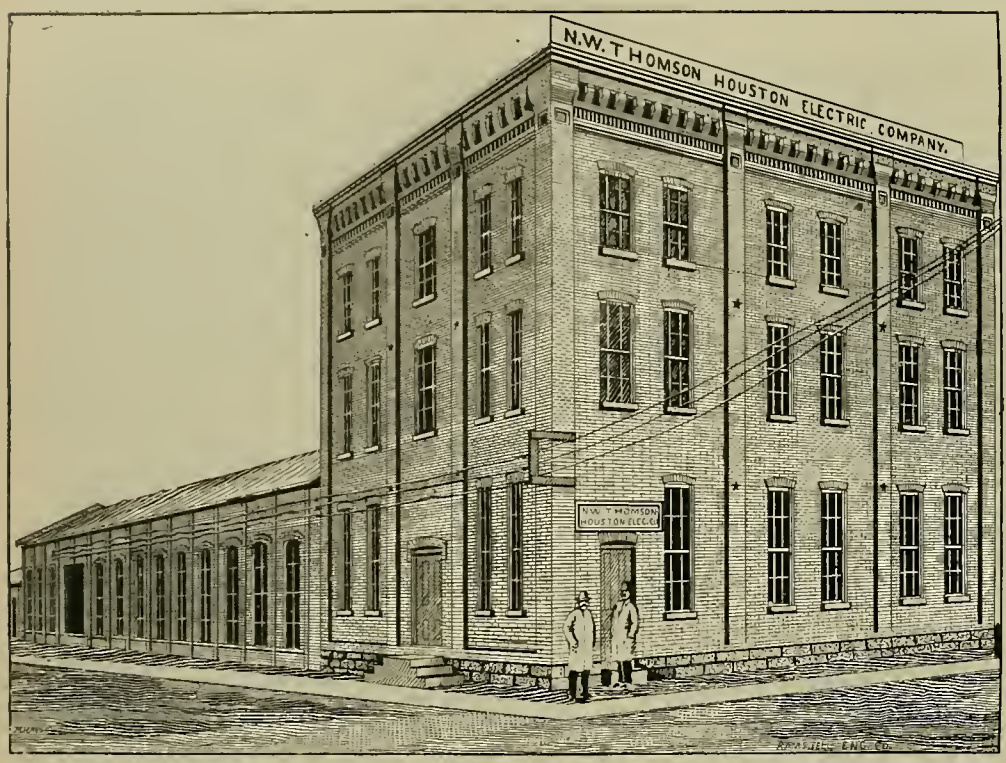


FIG. 1.—POWER HOUSE OF THE FOURTH AVENUE ELECTRIC RAILWAY, MINNEAPOLIS.

Fig. 1 shows the exterior of the power house which is a substantial and well-lighted building. The engine and generator room is illustrated in Fig. 2. In this room are three generators, engine and switch-board. Two of the generators are in motion, while the belt has been removed from the third, in order that a better view of engine may be given. These three dynamos are compound wound, and have each a capacity of 80 horse power. They deliver current at a pressure of 500 volts. Steam for the plant is supplied from a single Hazelton "porcupine" boiler of 250 horse power capacity. A Barr duplex steam pump furnishes water to this boiler through a Lambert heater. The engine used was designed by Russell & Co. of Massillon, O., and develops 250 horse power at a speed of 150 revolutions. A 36 inch double leather belt couples the engine to the countershaft over a double clutch pulley. On this countershaft are three similar pulleys for driving the generators.

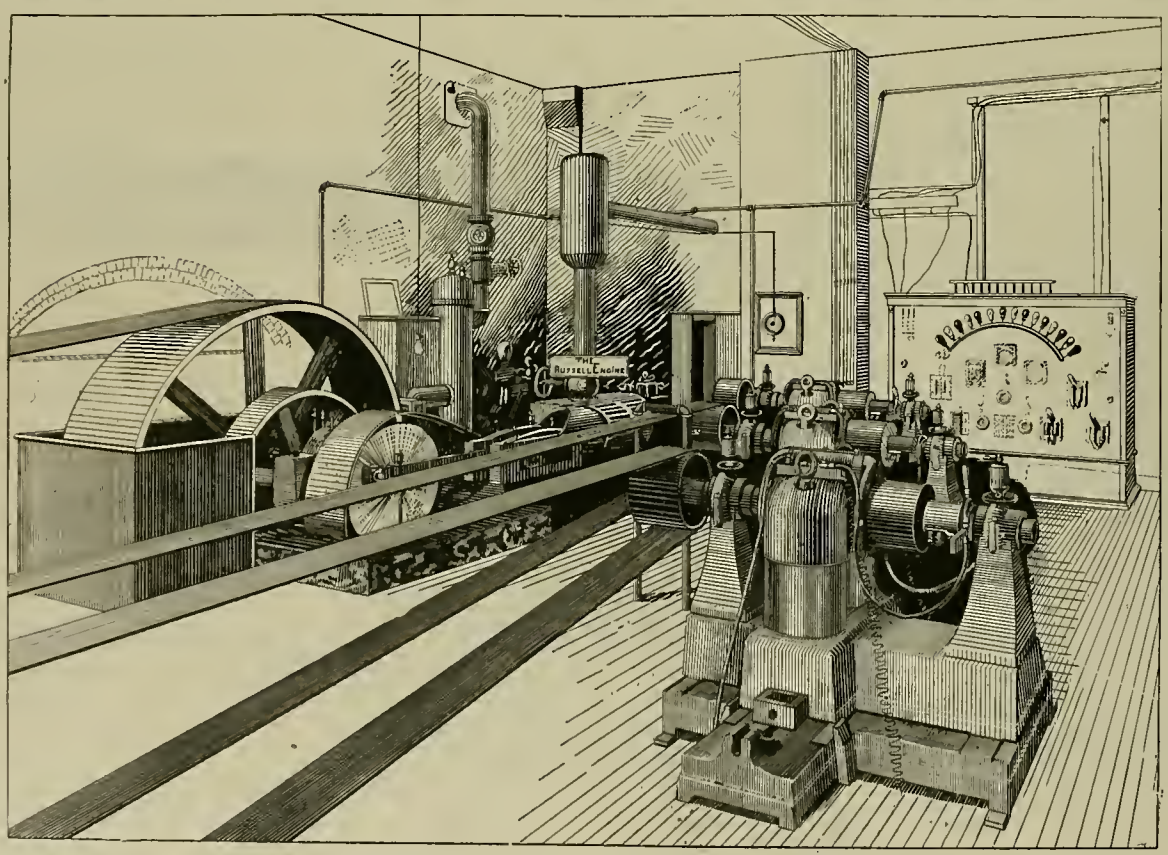


FIG. 2.—POWER HOUSE OF THE FOURTH AVENUE ELECTRIC RAILWAY, MINNEAPOLIS, MINN.

Important Patent Office Decision.

A recent decision by the commissioner of patents bearing upon the inclusion in one application of claims for the method and claims for the apparatus by which the method may be carried out, is attracting considerable attention among inventors. This decision classifies the cases in which this question arises into three branches—first, where division is impossible; second, where division is optional; third, where division is imperative.

Under the first class the commissioner discussed those cases where the invention was concrete and hence indivisible, as where a product and a process are so related to each other that the product can result only from the process and the process can only result in the product. The commissioner holds substantially as follows: While separate claims may be made for the product and process, there can properly be but one patent and hence but one application should be required by the office. So, also, where some of the claims cover a machine and others a supposed process, the latter being merely the function of the machine, one application is sufficient to secure the invention and is exhaustive of the applicant's rights. The same doctrine is also applicable where claims are formulated upon the same structure, some to cover it broadly, or in a general form, while others are specific in character. In all such cases a failure to fully or adequately claim a given invention can be in proper cases corrected by reissue, but a second original patent cannot be allowed under any circumstances.

Cases of optional division exist where the subject matter includes distinct inventions dependent upon each other and mutually contributing to produce a single result. In such cases it is optional with the applicant whether the several inventions should be claimed in one application or separated into as many applications as there are distinct inventions. The patents granted upon such applications are equally operative and valid. The inventions falling most frequently under this class are those relating to improvements upon machines, the proximate result of each and all of the improvements being to improve or modify the operation of the machine as a whole.

In cases arising under the third class the office is governed by an imperative rule requiring division whenever an attempt is made to include in one application two or more

inveotions which are independent, and which are not connected in design or operation, and do not mutually contribute to produce a single result. That process and apparatus constitute distinct inventions is too clear for argument, and it has been so decided over and over again by the Supreme Court of the United States, but whether they may be included in one patent depends upon the determination of the question whether they are dependent upon each other and mutually contribute to a single result.

A number of decisions are cited and discussed in which the Supreme Court has sustained patents covering both inventions, one of the latest being that in the telephone cases, in which the patent covered both the magneto and variable resistance methods, and the particular magneto apparatus described, or its equivalent.

Coal Consumption in Electric Light Plants.

Editor WESTERN ELECTRICIAN.—May I ask if you have not made a mistake in your printed report of the proceedings of the National Electric Light association, just adjourned at Kansas City? The error, for such I take it to be, occurs in the article of C. C. Haskins on "Prodigality in Economy." The writer in the course of his remarks refers to a fourteen-dynamo station, the operation of which has come under his observation and credits the plant with a coal consumption of 1,900 pounds daily. There is room here for the correction I am in search of. Nineteen hundred pounds daily can not be correct, while 1,900 pounds hourly seems too much. I presume the figures given are wrong and respectfully ask to be enlightened further. I disclaim any intention of quibbling over trifles, and do not ask for the information sought, out of idle curiosity.

I am deeply interested in this question and read with avidity any figures that claim to represent actual working results achieved in the operation of electric lighting plants. Such published statements are entirely too few to suit the searcher for knowledge of that kind I run an isolated station in this territory, not a large one, but still large enough to enable me to make a fairly successful attempt at economical operation. I must confess candidly and regretfully that my plant does not begin to approach in economy this one of Mr. Haskins One barrel of oil in thirty days is *remarkable*. It is too bad that the name and location of this plant cannot be furnished to interested parties, of whom I am one. I can not imagine anything but modesty that could keep this light shining under a bushel. Will some one please turn the measure over?

ENGINEER.

Central Spark Arresters.

The accompanying cuts illustrate a device to prevent the dropping of sparks from arc lamps. Complaint has frequently been made that sparks have fallen and damaged or destroyed goods

FIG. 2. CENTRAL SPARK ARRESTER.

over which the lamp was suspended, and in many cases the use of arc lamps for indoor lighting has been discontinued for this reason. The arrester rests upon the top of the globe, and reaches up to and around the cylinder of the lamp, inclosing all the intervening space, and thus prevents the escape of the heated particles of carbon. The device is made to fit any inside frame lamp, and all outside frame lamps where the cylinder is suspended from the inside of the top of the frame.

Fig. 1 shows the arrester removed while the lamps are being trimmed. Fig. 2 shows the arrester in position upon the lamp. A rubber flange or apron fits tightly around the top of the globe, and the body of the arrester being of wire cloth, there is a free escape for heat. The device is introduced by the Central Electric company, Chicago.

Industrial Exposition at Boston.

The Massachusetts Charitable Mechanic association of Boston, is preparing to hold its triennial exhibition in that city. This association held its first fair in 1837, and will hold its seventeenth in 1890. The building is located on one of the broad avenues of the city, with

FIG. 1. CENTRAL SPARK ARRESTER.

street cars in front and steam cars in the rear, with acres of floor surface, powerful engines and multitudinus conveniences for the accommodation of exhibits, exhibitors and visitors. In this exhibition will be gathered together the latest improvements in all classes and kinds of machinery, much of it in operation. The managers in their circular announce among the attractions: "Most wonderful of all, perhaps, such an exhibit of the latest devices in electrical science as shall show to all who attend, the marvelous progress which a few years have wrought in all that pertains to our everyday life, by the introduction of mechanism required to utilize that subtle universal force—symbol of unbounded concentrated energy—electricity."

Chicago Electric Club.

At the meeting of the Chicago Electric club, March 3rd, the library committee reported that it had been successful in making an arrangement with the American Electrical society, by which the latter's library will be transferred to the rooms of the club. This is an excellent arrangement for the Electric club, as this library contains some rare volumes, some of which have a present market value of forty or fifty dollars each. Mr. Kempt, the chairman of the library committee, reported that it was the intention of the committee to add to this library every desirable book published, and make it the best and most complete electrical library in the country. The meeting was largely attended, and the utmost enthusiasm prevailed in regard to club affairs. Dr. Paul Schoop of Zurich, Switzerland, read the most valuable paper on accumulators that has appeared in this country. This paper will be found on another page.

The secretary reported that seventeen new members had been elected since the last meeting of club, each application for resident membership being accompanied by $26. The finances of the club are in a flourishing condition.

The committee on the banquet to the eastern delegates to the Kansas City Electric Light convention reported that their funds showed a surplus of $20.13 after all bills connected with the entertainment are paid.

Rapid Transit in St. Louis.

The problem of rapid transit for St. Louis has occupied the attention of the best street railroad engineers of the country during the last year, and the determination of the people to secure better means of transportation has led the street railroad companies to make an honest effort to improve the service. It may be that the recent movement favoring elevated roads increased the anxiety of the surface road managers to improve the service, but at any rate there has been a perceptible awakening on the part of the management of the local companies to the necessity for prompt action. Inasmuch as the principal street car lines are controlled by the Holmes syndicate of Chicago, it is not strange that an effort to introduce the cable system in which these gentlemen are interested was made, nor is it strange that the people immediately repudiated the arrangement. So pronounced and widespread was this opposition to the cable that the projectors of the enterprise were compelled to change their programme. The people demanded electric roads, and the company hastened to introduce bills in the municipal assembly granting the right to substitute electricity for animals on all its lines, excepting a few unimportant routes which have already been equipped with the cable system. It is probable that as soon as the changes now contemplated are made, the cable lines will be obliged to fall in and adopt the electric system, so strong is public opinion on this point. The proposed changes will require an expenditure of at least $5,000,000.

The Lindell street line of St. Louis, Mo., has awarded a contract to the Sprague company to equip its entire line with electric apparatus. Double bracket iron poles placed between the two tracks will be used, and will be of an ornamental and tasteful design. Each pole will carry an arc lamp and so will act for the double purpose of lighting the street and carrying the trolley wires. The only wires overhead will be the trolley wires. The main feeder and arc light wires will all be carried underground. The last order of this company for electrical apparatus includes one hundred and thirty-six motors, and it is intended to have the road in operation as soon as possible.

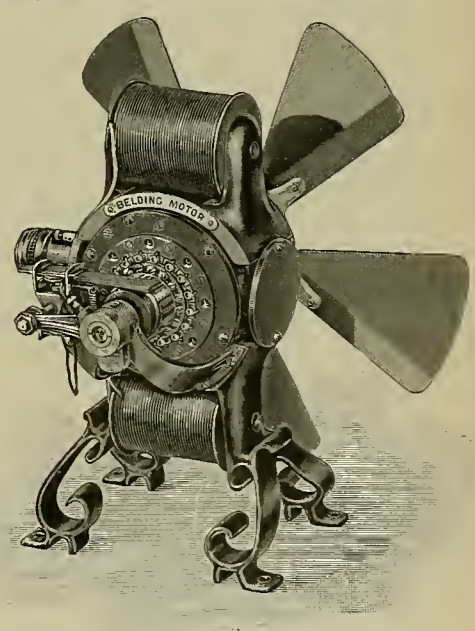
John Stephenson and Electric Cars.

In an interesting sketch of John Stephenson, the *Sun* says while speaking of the wide development of his business: "The electric car business is becoming the largest branch of car building now, and the very newest of the cars are made for the Fourth avenue line in this city. It makes an interesting showing in comparison with the old "John Mason," and placed actually side by side, the difference would be still more startling. The old cars used to cost about $800 on an average. Nowadays $1,000 buys an ordinary car, but the best cost as high as $1,600, and the electrics, with their motors, cost $5,000, not to speak of $2,000 more for batteries, if they are that kind of cars. They are built of the finest and strongest wood, elaborately carved and painted, and all the "fixings" are bronze or brass, while almost as much care is taken with their doors, windows, shades, seats, and other features, as if they were palace cars.

New Belding Fan Motor.

The accompanying cut illustrates a new fan motor which is being introduced by the Belding Motor & Manufacturing company, Chicago. In general design the motor is neat and tasty. The fan is six-bladed, measuring fifteen inches from tip to tip of two opposite blades. Where it is not desired to have the fan attached directly to the armature shaft a belt may be used, and an eighteen-inch fan substituted.

The fan itself is of peculiar construction. By an ingenious curvature of the blades, it is claimed, the air is delivered in a solid column,



NEW BELDING FAN MOTOR.

so to speak, instead of being scattered. This motor, it is claimed, develops fully ⅛ horsepower and is of high efficiency. The armature shaft runs in self-oiling boxes and the machine is practically noiseless. A special feature of the motor is the novel arrangement of the brushes. It will be noticed that both are supported by one brush holder stud. Carbon brushes are used. The speed is changed by shifting the brushes. This motor is wound for 110 volt circuits.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
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J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE electrical execution law is now before the court of last resort in New York state. The arguments of counsel on the appeal are summarized in the New York letter. The appeal is made principally on the ground that the law providing for the infliction of death by the application of electricity is unconstitutional because the penalty is cruel and unusual. The general opinion seems to be that the court of appeals will sustain both the county court and general term, which have both affirmed the constitutionality of electrical execution. It will be remembered that the committee on state and municipal legislation brought this matter before the National Electric Light association at the recent convention at Kansas City. It was voted that an effort be made to secure an amendment to the electrical execution act to the effect that special apparatus be devised for death dealing purposes capable of generating current at a potential of 10,000 volts. It was also stated at the convention that Governor Hill was averse to the repeal of the act, so it is extremely unlikely that he will interpose a pardon in order to prevent an execution under the new law. If the validity of the law is affirmed every one will be interested in learning of the circumstances attending the first execution. It is therefore to be hoped that a measure recently introduced in the New York legislature which repeals the prohibition against the publication of anything in regard to an execution beyond the mere statement that death was inflicted, will be adopted. It has been asked repeatedly and very pertinently, "How are we to know whether the electrical method is cruel or not, if we are not allowed to learn of the details?" The bill repealing the prohibitory clause has reached a third reading, and it is said will probably be adopted by the legislature.

AN interesting paper on the "Theory of Accumulators," which appears elsewhere in this issue, was presented at the last meeting of the Chicago Electric club by Dr. Paul Schoop of Zurich, Switzerland. The author premises his paper with an explanation of the sulphate theory. He describes briefly the mode of making lead accumulators and discusses the action of charging and discharging. This is followed by the statement of a theory which, he explains, has already been suggested "by Faraday fifty years ago in his celebrated Experimental Researches on Electricity." Dr. Schoop bases his views on "the power of metals and other solids to induce the combination of gaseous bodies." This he claims explains known facts in a more simple way than the sulphate theory. Dr. Schoop calls attention to the fact that cells may be constructed of high capacity by the use of lighter metal than lead. But he also states that it is his conviction that there is much more to be looked for in the development of the lead cell.

IN another column there is presented a paper entitled, "Sir Wm. Thomson and Electric Lighting," by George Westinghouse, Jr. Those familiar with current electrical literature will not be much surprised at the tenor of the article. In the introduction the author refers to Sir Wm. Thomson's recent article on "Electric Lighting and Public Safety," and calls attention to the evident determination of the authorities in Great Britian to virtually prohibit aerial wires. Following in this line of thought the writer points out the danger attendant upon the use of electrical energy. The advocates of the various continuous current systems will note with interest Mr. Westinghouse's reference to the late fire in the Pearl street Edison station in New York, and also his remarks concerning the incident, related in the *North American Review* by Mr. Edison, where paving stones were "reduced to a molten mass." Mr. Westinghouse concludes his paper by proposing a set of regulations, the first of which reads as follows: "No direct electrical connection shall be permitted between street mains and wires within buildings for either light and power." It is hardly necessary to point out that there are a few of the electrical fraternity who would oppose such a regulation.

JUDGE LANDON of the Supreme court of New York, has written an interesting opinion, summarized elsewhere, in the injunction proceedings in which the Hudson River Telephone company endeavors to restrain the Watervliet Turnpike & Railway company from introducing the electric system on its lines. The judge finds that under its franchise the railway company has a right to operate by electricity, and while it may claim an equal right with the telephone company to use the earth return, it cannot do so if it seriously interferes with the operation of established telephone lines. The judge bases this decision on the ground that neither company has an exclusive right to use the streets. Judge Landon thinks that the proper method of removing disturbances on the telephone line is to be found in the adoption of the metallic circuit by the telephone company. In this respect he differs with Judge Taft, whose decision in the telephone-electric railway suit at Cincinnati was published last week. The latter thought the problem would be solved when the electric railway company adopted the double trolley system. He, therefore, enjoined the railway company from continuing to use the single trolley system. Judge Landon says the question who shall pay for the metallic circuit should be determined in a court of equity. Another point upon which Judge Landon differs from Judge Taft, relates to the merits of the single trolley system as compared with the double trolley system. Judge Landon says the former is superior to the latter when the mechanical, electrical and financial features are considered. In view of the fact that both the telephone and railway companies can operate their systems on the same streets, Judge Landon says they should adopt upon equitable terms such methods and safeguards as shall prevent interference with each other, and protect themselves. He, therefore, orders the railway company to file the necessary bond guaranteeing the possible damages until the case in equity is decided.

IN an article in another column, views which Lieut. Sprague expressed in his paper at Kansas City, are considered by Nelson W. Perry, E. M. Mr. Perry testified as an expert in the electric railway-telephone suit before Judge Taft at Cincinnati, and it was upon his statement, as an electrical expert, that the judge based his opinion, which was published in these columns last week. Mr. Perry takes exception to the statement of Lieutenant Sprague that, "as a matter of fact, the trouble from induction is of the very slightest character, and that must be patent to any one who is familiar with this particular electrical action." On this point Mr. Perry says: "We cannot say that in one case either induction or conduction will be the predominating disturbing element until we have actually tested the case in question. This is so, not because the nature of or laws governing induction are imperfectly understood, but because there are many modifying causes that cannot certainly be predetermined, either as to their existence or extent." Mr. Perry then relates his experience in tracing the causes of disturbances on telephone lines in the same street with the electric railway, and the conclusions to which these examinations have led him.

ARTICLES on the general subject of safety in the distribution of electricity continue to find a prominent place in the magazines. In the March number of the *Atlantic Monthly*, Prof. John Trowbridge treats of this general topic under the title of "Dangers from Electricity." He refers to the sources of dangers and to the necessity of employing safeguards. He dwells particularly upon overhead wires for electric cars and expresses his decided preference for the double trolley system. In this respect his views coincide with those of Judge Taft, who recently enjoined the defendant in the telephone-electric railway suit in Cincinnati from continuing to use the single trolley. Electric railway men will almost without exception disagree with both Prof. Trowbridge and Judge Taft on the advisability of using the double trolley. After pointing out the dangers to be guarded against in distributing the electric current, Prof. Trowbridge reaches the following conclusion which every one will indorse: "In general, electricity may be said to be the safest natural agency which man employs. Steam boilers burst, and gas mains explode. There is nothing explosive in an electric generator or an electric motor. The wires conveying the current can rend nothing, and become heated only through gross carelessness. The ease with which electric plants are installed testifies to the ready adaptability of electricity to man's uses. This ease has a tendency to make electrical working men careless, and it also leads to the employment of ignorant persons." The carelessness and tendency to employ ignorant persons, to which Prof. Trowbridge refers, are becoming less and less common. It is generally recognized that carelessness in construction in New York city led to the scare which created the demand for articles on the dangers of electric lighting. At the Kansas City convention of the National Electric Light association, the necessity of securing the best possible workmen was repeatedly emphasized; in fact, one of the most interesting discussions turned upon the very point of obtaining workmen who would not be careless. There certainly is no tendency at the present day toward the employment of ignorant persons or toward the encouragement of careless methods,

A Theory of Accumulators.[1]

DR. PAUL SCHOOP.

Though the development of science, and especially that of the electrical branch, has shown that practical results may be obtained more easily by exact observation and experiment than by theoretical speculation, and that theories commonly are built up, after a discovery has already been thoroughly proved by actual experience, still the value of theories is not trifling, even if we consider only the impulse which a theory may give for further investigations. When we see how the theory of Gisbert Kapp has facilitated the proper construction of dynamos, why should we not look for a better theory of accumulators? Consult the books and periodicals and you will ascertain how contradictory and how confusing are the explanations of the action of the accumulator. Indeed, it seems to be a fact that the first investigators at the beginning of this century had a clearer idea regarding the electro-chemical changes in the lead accumulator than we now possess. As the knowledge of the properties of the lead secondary battery was extended, the more difficult it was found to encompass all the phenomena in a single theory. Chemistry has certainly become an extended science, so also has electricity, but electro-chemistry, founded by the genius Faraday, has developed but little since his time. It is for this reason, perhaps, that the present theory of accumulators is still very objectionable; it is equally true that the opinion expressed here will not be the best that could be wished, though it explains the known facts in a more simple way than the "sulphate theory," as I will call the old one.

OLD OR SULPHATE THEORY.

Without going into the historical development of the accumulators, let us consult one or two of the most widely read books. Referring to "The Management of Accumulators," by Sir David Solomons (1890), page 53, we find that the charging of the lead accumulator is alluded to as follows: "The result of charging is to convert the $PbSO_4$ on the positive plates to PbO_2, which change is thus effected: SO_2 goes to the electrolyte in exchange for O, the liberated H_2 of the water, joining with the SO_4, form H_2SO_4. The next action is another atom of O joining the PbO, making PbO_2, and the liberated H_2 of the H_2O going to the PbO of the negative plate, forms Pb_2H_2O." Do not get scared. I do not expect you to understand this explanation. I am sure I am unable to comprehend it myself. Emil Reynier in his "The Voltaic Accumulator," translated by A. Berly (1889), says on page 13: "The double reaction thus enacted (by the discharge) is the fixation of one equivalent of sulphuric acid upon each electrode, and the carriage of one equivalent of oxygen from the positive to the negative." And on page 14: "When the voltameter is charged anew, the reverse chemical reactions take place, bringing the sulphate of lead to a state of reduced lead on the one part, and of peroxyde of lead on the other part." That is, at least, a clearer explanation, and it represents the modern opinion, as all researches made in the last few years refer to a similar or the same view. You will remember a paper read by Prof. Frankland last October before the Royal society, London. His researches lead him to the opinion that in the electrodes of a lead accumulator there were active two new compounds, one in the negative plates and another in the positive plates; both consisted of combinations of lead, oxygen and sulphur, but arranged in a very complicated manner. Though the method by which the investigator obtained these two new substances may be considered suspicious by chemists, it is of little consequence, the important point being that the sulphuric acid is the material necessary to produce "active material" in combination with lead oxides. As the opinions of three authors have been cited, it may be said that a few electricians do not share the general belief. Mr. Fitzgerald of London, was unable to find lead sulphate in the positive plate in his lithanode battery, and Mr. Bandsept of Brussels, modestly believed that we know nothing certain about the chemical reactions in a secondary cell.

I shall attempt briefly to describe the mode of making lead accumulators, the action of charging and discharging, and to point out the facts which support or seem to support the present theory. I shall then try to explain the phenomena in another way, and will endeavor to support this view by facts well established by well-known processes, but principally by "Faraday's Researches."

Two lead foils, say $\frac{1}{100}$ of an inch in thickness, are connected, the one to the positive pole, and the other to the negative pole of an electrical source; both foils are suspended without touching each other in a vessel filled with water acidulated by sulphuric acid. We have then suitable apparatus for making a lead accumulator. If the current is turned on—it must be a continuous current, the pressure being from three volts upwards—it is found by careful observation that during the first few moments no visible change in the electrolytic vessel takes place. Soon, however, the decomposition of the fluid becomes visible, gas bubbles appearing on both foils. Faraday calls the electrode, at which the hydrogen appears, the *kathode*, and the other, at which the oxygen is developed, the *anode*. The main result of this experiment, which we may call "charging of the cell," consists in the development of hydrogen and oxygen gas; but after a few minutes the anode loses its greyish lead color, and becomes dark brown; while the kathode no longer presents a bright metallic surface, but shows the same grey color as before. If the charging is continued for a considerable time, say a fortnight or a month, the superficial brown substance will become a coating on the anode surface of a certain thickness, perhaps $\frac{1}{100}$ of an inch; the kathode looks rather smooth. By means of a voltmeter we find during the charging, and we could have ascertained the fact at the beginning, that between the two lead foils there is an electromotive force of $2\frac{1}{2}$ volts, and breaking the charging current, the difference of potential will be found to be exactly two volts. Further it is found that when the two poles of the element are connected an electric current is flowing, but exact measurement will prove that the quantity of current is very small, and by no means in proportion to the amount of current employed during the charging period. A chemical analysis of the anode, the black electrode, on which the oxygen has been developed, will prove that the black compound contains not only lead but oxygen, and if the water and the sulphuric acid have not been removed before the analysis by washing and drying, these ingredients will be found. An analysis of the kathode, after washing and drying, will only prove the presence of lead.

Having charged our lead accumulator for a month, we will reverse the current. After an hour, the former kathode assumes a brown color, and the former anode loses more and more its dark appearance, the color turning from black to chocolate brown, then to yellow, and at last into a grey lead color, perhaps a little lighter grey than at first. No gas bubbles appear on this plate, till it has turned entirely, while the other plate develops gas soon after the reversal of the current. Let the current be maintained for a month. After this time, the former kathode (now anode) has a black coating of the same thickness of $\frac{1}{100}$ of an inch, and the former anode (now kathode) has a soft, grey surface. We have now a good accumulator, the electromotive force between the two foils during charging is, as in the first period of charging, $2\frac{1}{2}$ volts; where the current is broken, the difference of potential is exactly two volts. The sulphuric acid is a little more concentrated, as water has removed from the solution by the decomposition. The only difference between the present cell and the cell before the reversal of the current is, that we can take out of it a considerable amount of current. And further, if we charge the cell again at the proper rate of current, and if we stop the charging as soon as gas-bubbles appear, we can obtain in the discharging from 80 to 85 per cent. of the total electric energy expending in charging. Why is it that the accumulator nearly inactive at first, turned out so well in the second reversed charging? It is, apparently, because the kathode has now a coating of spongy lead $\frac{1}{100}$ of an inch in thickness, for this is the only difference between the two states. This is a complete description of making an effective accumulator.

But where is the "paste," that material interesting for more than one reason? It will be seen from the above that effective accumulators may be obtained without paste, but why is that all those in practical operation contain that "paste"? I will recall to you the fact that the first batteries, made by Plante, had no paste whatever, and the use of that material was first made much later by Faure. Faure thought that, instead of forming at first a layer of oxydized lead, the black compound, which is very costly, considering the enormous amount of current (work) and time necessary for its production, it would be more economical to make it at a small expense by chemical means, and to apply it mechanically to a lead plate or grid. He found that other compounds of lead, like litharge or minium, would be equally serviceable. He filled two perforated plates with a paste made by mixing minium (red lead) with a little dilute sulphuric acid in just such quantities as to form a pasty mass. After the "paste" had been allowed to dry a little and become hard, the plates were immersed in water, acidulated with sulphuric acid and current was turned on. The lead oxide on the anode become dark-brown and that on the kathode was changed into spongy, metallic lead. This element will, after the first charging, give a large amount of electrical energy, owing to the large quantity of spongy lead obtained by this means. This is the method of making accumulators followed by the Electrical Accumulator company, and by the other companies, which do not own all the Faure patents. I hope these companies will pardon me for revealing their secrets, as they are of little value without the additional knowledge of a great many practical points without which accumulators cannot be manufactured and successfully operated.

We must now consider the lead-accumulator more closely, especially in respect to the chemical changes, which are the same in the case of either a pasted or a non-pasted plate. The specific gravity of the dilute sulphuric acid in the cells is ordinarily 1.175 (corresponding to about 25 per cent. concentrated acid), and during charging we see that the specific gravity increases, after fully charging to perhaps 1.220 (corresponding to about 33 per cent. concentrated acid). Every ampere-hour, as the common expression is, sets free about $\frac{1}{100}$ pound of concentrated sulphuric acid, so that a 200 ampere-hour charge would evolve one pound of acid. Of course this acid must have been in the plates, for 200 ampere-hours' discharge a pound of acid seems to have disappeared. Suppose the cell contains about 27 pounds of dilute acid of 1.220 specific gravity after charging, and 27 pounds of dilute acid of 1.175 specific gravity after discharging 200 ampere-hours, exactly a pound of the concentrated sulphuric acid "has gone into the plates," to use the common expression. Again, on charging the cell with 200 ampere hours, we find the old specific gravity of 1.220 restored; that speaks for the old theory, which has still other arguments in its favor. Lead plates, charged in pure water, an operation difficult to accomplish, as water scarcely conducts the current, present an entirely different appearance both in electrical and chemical conditions from those dipped in acidulated water. One theory of electrolytes, which consists in assuming, that only that only those bodies which conduct the current under decomposition, and water does not conduct current, are electro-active in a voltaic cell, again supports the view that it must be the sulphuric acid which is decomposed in the secondary cell and the water only incidentally. Further, it has been found that the plates of a lead cell, especially after a discharge and subsequent rest of several months, contain large quantities of real lead sulphate, called white sulphate, on account of its color. This can be observed on both negative and positive plates. Before the so-called discoveries of Prof. Frankland we knew other forms of lead sulphate, such, for example, as gray sulphate which, on account of its color and for other reasons, cannot be readily distinguished. The gray sulphate, however, must be in the plates, because the white sulphate is not decomposed by mere charging, but remains unchanged. This does not conform to the theory. On page 76 of Solomon's "Management of Accumluators" there is this interesting paragraph: "To return to the cure for sulphating (this means the elimination of the white sulphate from the plates) a continual charging below the maximum rate, half to start with, for a prolonged period, will gradually reduce the unhealthy (!) sulphate to the healthy form." By the way, chemistry knows only one sulphate of lead, the very white sulphate.

It must be admitted, that the analysis of lead electrodes is difficult, on account of the chemical changes which take place even if electrodes are surrounded by air or water only. But still another reason speaks for the old theory; some investigators succeeded in calculating the caloric relations between sulphuric acid and the lead compounds so as to obtain an electromotive force of nearly 2 volts for a cell. And how nicely they develop the analogy to a primary cell, the Daniell element for example thus: "Replace the kathode by a zinc plate, the anode by a copper plate, and the sulphuric acid by a solution of sulphate of copper, or even start with the same sulphuric acid. The chemical reactions during discharging are: Sulphuric acid combines with the zinc (kathode), forming sulphate of zinc. During charging sulphuric acid dissolves the copper of the anode, combining to form sulphate of copper."

Let us now investigate the failures and contradictory character of the sulphate theory. We first encounter the striking fact, that if the theory is correct we should obtain seven times greater capacity out of a given weight of plates than we now are able to secure. We may put forth every effort to utilize the active material in the most favorable way indicated by theory and experience, but we are still unable to get around this awkward fact. The best illustration of the truth of the statement is found in a comparison of the cells of different inventors. It has been found repeatedly that the capacity is practically the same in all these makes and is found to be just about one-seventh of what it should be according to the sulphate theory. One pound of active material in the negative plates should allow us to store up about 125 ampere-hours, and we find, as a matter of fact, that we need seven pounds for this purpose. If we accept this theory we must dispense with chemical laws, which till now at least have been regarded as exact and unchanging. They have taught us that for each atom deposited by electrical energy a certain and invariable amount of electricity was requisite. Faraday determined the atomic weight of many elements by comparing the quantities of current necessary for the deposit of equal weights of the elements. Does this law of electro chemical equivalents, which holds good for all primary batteries, only fail in the case of the lead accumulator? That is incredible. Another awkward fact is, that the electromotive force of a lead accumulator varies during charging and discharging. It may be that the variation of the resistances, both of the electrolytic fluid and of the plates may partially account for the variation; but there is also a variation in the difference of potential. We may say, that where a chemical compound is decomposed by electricity the energy required to effect the decomposition is invariable; for example, in depositing copper in electrotyping the necessary electromotive force is constant, provided the current is constant. A good primary cell, say Grove's, retains the same difference of potential nearly to the time of its exhaustion. The difference of potential between two chemical compounds cannot be variable. And yet in the discharge of our lead plates we obtain at first 2 volts, after a certain time 1.9 volts, and later, before the accumulator is exhausted, 1.86 volts. Further, it is still doubtful whether sulphuric compounds are present in the electrodes, the kathode as well as the anode. The difficulty of analysis has already been conceded; indeed, if there were other sulphates of lead in existence we should be able to isolate and prepare them in a state of absolute purity. Nobody has ever accomplished this; on the contrary there is an absolute uncertainty concerning the constitution of such lead sulphates. The sulphates of Prof. Frankland were obtained in a way, which disregards all known methods of preparing definite chemical compounds; an analysis of a mixture of lead oxide and sulphuric acid will never prove the existence of a new chemical compound. It has already been proven that the only white lead sulphate is unfit for storing up electricity.

Compounds of lead similar to those found in an accumulator, but obtained by purely chemical means cannot be effectively used for constructing a lead accumulator. Even peroxyde of lead, obtained by chemical action, is not the same substance as that black compound on the charged anode, though both agree in containing relatively great percentage of oxygen; but the physical properties (colored, crystal form and specific weight) and the chemical properties (power of oxydation, difference of potential with liquids and constancy) are different in the two peroxydes of lead. No one has ever tried to obtain a charged kathode by chemical means.

ANOTHER THEORY.

There are surely sufficient reasons for looking for another theory which will harmonize with others. I will endeavor briefly to state my own view, which is based on the theory suggested by Faraday fifty years ago in his celebrated "Experimental Researches on Electricity." (Second edition, Vol. 1, 1849.) On page 165 is the following Sec. 12. "On the power of metals and other solids to induce the combination of gaseous bodies." 660. I intended to have followed this section by one of the secondary piles of Ritter, and the peculiar properties of the poles of the pile or of metals through which electricity has passed, which have been observed by Ritter, Van Marum, Yelin, De la Rive, Marianini, Berzelius and others. It appears to me, that all these phenomena bear a satisfactory explanation on known principles, connected with the investigations just terminated, and do not require the assumption of any new state or new property.

If a platimun-foil is dipped into a mixture of 2 volumes of hydrogen-gas and 1 volume of oxygen-gas, a sudden ex-

[1] Read before the Chicago Electric Club, March 3, 1890.

plosion occurs, just as if an electric spark or a flame had ignited the mixture. The experiment is made with hydrogen-gas only, no explosion occurs, but if the platinum is now taken out of the hydrogen and exposed to the air, it becomes red hot within a few seconds and then the foil again cools off. The platinum may be put again into the hydrogen and when taken out the same phenomenon will be observed. This experiment can be repeated indefinitely. If the platimun, after the exposure in hydrogen, is now dipped into a solution of certain chemical compounds, for instance ferric cyankali, (iron peroxide of potassium) the chemical combination of the solution is changed and the latter contains after a little time a new substance, ferrocyankali, a compound containing less oxygen than the original compound. It was observed by Faraday, that during the heating of the platinum in the air, steam was set free and he concluded that the platinum must previously have absorbed a considerable quantity of hydrogen gas. If the platimun foil is made the kathode of a voltameter filled with dilute sulphuric acid it will absorb the greatest quantity of hydrogen. The hydrogen, which is developed by passing a current through the fluid is at first completely absorbed by the platinum, as is also the oxygen-gas, and only after the saturation of the kathode with hydrogen does the gas appear in visible bubbles. Such a charged kathode will become instantly red hot when exposed to air or to oxygen. The kathode is found to develop more energy than the same plate, simply immersed in hydrogen gas and not acted upon by an electric current. The platinum-voltameter with dilute sulphuric acid, often used in calibrating ampere meters is an accumulator; an expensive one to be sure, considering its small capacity contained in a certain weight of platimun. If we first charge the platinum-voltameter by passing through it a current and then connect the two poles, a reverse current, the so-called "polarization current" or "secondary current" is obtained. Faraday constructed a gas battery and at the same time a platinum accumulator as follows: Two glass tubes, *A* and *B*, each provided with gas cocks, Figs. 1 and 2, are so made as to be easily filled with a fluid. Each tube contains a platinum wire. The tubes are placed in a vessel *V* containing dilute sulphuric acid. The tubes are filled with the same acid and the current turned on, Fig. 1. Hydrogen liberated in tube *B* is partly absorbed by its platinum-wire; oxygen liberated in tube *A* is also partly absorbed by its platinum-wire. After breaking the charging currents and connecting the poles of the voltameter through a galvanometer, we observe a current in the reverse direction, while the gases in both tubes disappear gradually. This is our fundamental experiment in support of another theory. It proves that between the hydrogen absorbed by the platinum and the dilute acid, there is a certain potential difference, and that the hydrogen disappears in just the same ratio that the current is taken out of the voltameter. Of course, there is absorbed on the other side oxygen in the platinum-wire, which has a potential of the opposite sign in relation to the dilute acid, otherwise we could not get as high a potential difference, over 2 volts, in the voltameter. Faraday proved in a similar way, the absorption of oxygen by a platinum-foil. Such a foil, charged as an anode in a voltameter acquires great oxydizing qualities. When such a foil is put into solutions of certain salts, say for instance, of thallium, the brown peroxyde of thallium is obtained, which could not be formed by the mere exposure of the same solution to ordinary oxygen gas. Faraday stated, that certain impurities on the platinum foil could prevent the absorption if the foil was not clean, or perhaps oily on the surface, no absorption occured; while a foil, thoroughly heated to a white heat and

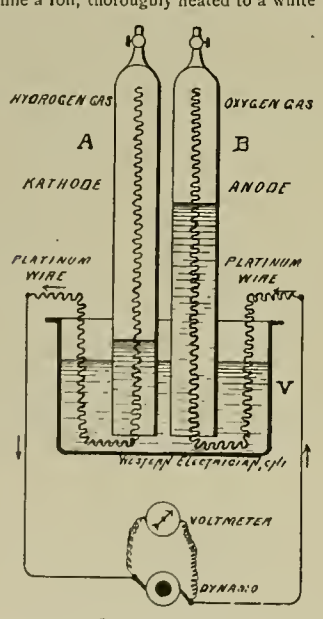

FIG. 1.—A THEORY OF ACCUMULATORS.

immediately after cooling, put into hydrogen, absorbed rapidly. The same foil, after having been in the air for a longer period, did not absorb half the hydrogen as in the former case. Impurities of hydrogen could hinder the absorption; small quantities of dethylen gas or vapors of turpentine would prevent the absorption. To obtain a clear platinum kathode, it was found advisable to make it first, the anode, the oxygen burning all impurities away, and then to make it the kathode. Platinum is by no means the only metal capable of absorbing hydrogen; there are many others, such as palladium iron, and mercury. Palladium absorbed even more hydrogen than platinum. The following data will be of interest: It was found that palladium wire, about one-fiftieth of an inch in diameter, used as the kathode in a voltameter, would absorb 1,000 times its volume of hydrogen gas, or 3 per cent. of its weight. Hence a pound of palladium wire would store enough hydrogen to deliver about 36 ampere-hours. This is not an encouraging fact And though the volume of hydrogen is large, the weight is trifling. In Fig. 3, the circles, illustrate the proportional cubic dimensions of equal weights of platinum (or palladium), water and hydrogen.

Assuming the weight of 1 volume of hydrogen as one pound, the weight of the same volume of platinum will be 256,774 pounds. Zinc is ten times more effective than

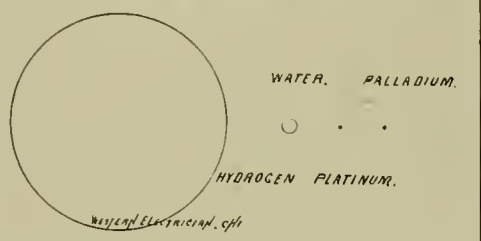

FIG. 3.—A THEORY OF ACCUMULATORS.

palladium, charged with hydrogen; one pound of zinc giving about 400 ampere-hours. It has also been found that the palladium wire expands during the charging, and that in a saturated condition, it has a volume 3 per cent. larger, than at the beginning. After the discharge, the wire resumes its original volume. Palladium wire absorbs only a trifle of hydrogen by dipping it into the free gas, about three times its volume. Between the paliadium and the sulphuric acid (sheet, wire or sponge) there is a variable potential; the potential varying according to the amount of hydrogen already absorbed by the metal. It has also been observed, that the potential rises suddenly when the point of saturation is passed; there is also a continuous fall of electromotive force during the discharge of a palladium accumulator. We may say in short that the whole behavior of a palladium or of a platinum voltameter is in every way so similiar to that of a lead accumulator, that we would be at a loss to point out essential differences. The hydrogen is supposed to be held in the palladium, as for example, mercury in copper or zinc, and physicists speak nowadays of an *alloy* of palladium and hydrogen. I now propose the following theorem: "The charged kathode of a lead accumulator contains an alloy of lead and hydrogen, and this hydrogen-alloy is the true active material," If platinum, palladium, mercury and iron combine with hydrogen, why should not lead do the same? Take a charged, so-called "negative" plate out of an accumulator cell. After a few minutes vapors will rise from it and soon the plate will become so hot that the solid metallic frame will melt. Who can help remembering Faraday's platinum foil? Lead may be prepared in a most finely divided state, by reducing lead salts, say chloride of lead with zinc in an acid or salt solution; but this lead would not heat spontaneously as in the first experiment. We can easily see how the charged lead accumulator acts; the kathode contains hydrogen alloy and between it and the acidulated water there is a certain potential. The anode contains oxygen, however, not in a condensed state or as an alloy, and not firmly united, in a chemical compound namely that dark, black, most highly oxydized peroxyde of lead.

Now let us consider the discharge. As soon as the discharging commences the kathode loses hydrogen, and the black compound on on the anode loses oxygen; these gases, however, are combined and form water, which again is dissolved in the dilute sulphuric acid. For each pound of water formed in this manner about 700 ampere-hours are delivered. At the end of the discharge we have then the kathode containing lead nearly free from hydrogen and the anode, a chocolate brown compound containing less oxygen, then the black compound, and the electrolytic fluid containing a pound more water than before. The specific gravity of the acid of course must have fallen, because pure water has been added to it by the discharge. Now let us consider once more the discharge. The current decomposes the water. (It is a well known fact that bodies which scarcely conduct electricity become comparatively good conductors if mixed together, such as alcohol and water, hydrochloric acid water, sulphuric acid and water.) The hydrogen is absorbed by the spongy lead on the kathode, the oxygen is absorbed by the chocolate brown compound on the anode; a part of the water of the dilute sulphuric acid is decomposed and furnishes hydrogen and oxygen gas. After complete charging, the kathode again contains the saturated hygrogen alloy, the anode, the black compound, and the dilute acid less water than at the beginning of the charging, because a certain quantity of pure water was decomposed and removed. The specific gravity of the acid must have increased. The addition of about one-fifth of a pound of water to twenty-seven pounds of dilute acid of 1.220 specific gravity will give us the same specific gravity as the removal of one pound of concentrated sulphuric acid. These views, it is thought, will explain in a simple and satisfactory way all the phenomena connected with the action of lead accumulators.

The theoretical amount of current, obtained by a given weight of lead-sponge on the negative plate does not depend upon the atomic or molecular weight of the lead, but upon the capacity of the lead sponge to absorb hydrogen. This capacity is not constant, but depends upon different factors, viz: The more or less divided condition of the particles of lead, the temperature of the lead-sponge, and the manner of charging and discharging. Some years ago I made an interesting experiment with platinum-sponge. I prepared platinum-sponge by heating a compound, which contained 4.4 per cent. platinum (the so-called platinum-sal ammoniac.) I obtained another platinum-sponge by heating a similar compound, but which contained only about 2 per cent. platinum (platinum-chloride-strychnin-chlorhydrate.) If put into illuminating gas, the temperature of the first kind of sponge *slowly* rose to a red-heat, while the temperature of the second kind of sponge under the same conditions *at once* rose to a white-heat. This was probably due to the fact that the platinum-particles in the second sponge were in a more finely divided state than in the first. Now what is our experience in manufacturing accumulators with pasted plates? The capacity of the cells depends directly upon the degree of fineness of the powder employed for the paste. Lead sponge obtained for example by heating tartrate of lead can absorb more hydrogen than can lead-sponge obtained by reducing oxide of lead. The highest capacity is found in lead sponge in which all the particles are most finely divided within the largest space. If we press lead-sponge under a high pressure, we find a decrease of its capacity, and if we finely press it into a solid plate of lead, we will have to commence again with the old Plante forming-process.

Before closing my paper let me add a few remarks *about accumulators in general*. Besides the practical accumulator *par excellence* there exist other accumulators. Every primary element, which permits a restoring of the *status quo ante* by simply sending through it a current of reversed direction after it is exhausted may be termed an accumulator. We know of zinc-copper accumulators and zinc-lead accumulators, not to mention a variety of less important kindred cells. Only a year ago it was announced that the secondary battery of Commelin, Bailharte and Demazures was superior to the old accumulator in such a degree as to be fatal to the latter's existence. The principle of this new combination was based upon the Lalande battery now known here as the Edison-Lalande battery, for the commercial exploiting of which Edison has joined with the inventor. One electrode consists of zinc (amalgamated to prevent the dissolution of the zinc during the time of rest) and the other of highly oxydized copper, a black compound. The electrolytic fluid is caustic potassium, dissolved in water. During the discharge, zinc is dissolved and the black copper compound reduced to a red substance. During the charge the dissolved zinc is again deposited on the remaining zinc electrode and the black copper compound is restored. This is the working action of the copper-zinc cell.

A zinc-lead cell was constructed by Meserole; it consists of an amalgamated zinc electrode, in a most spongy condition, and an electrode coated with the well-known black lead compound. The exciting fluid is a solution of sulphate of zinc in water with small amounts of sulphate of mercury and free sulphuric acid. Zinc is dissolved and black lead is reduced during the discharging; zinc with a little mercury is deposited and the black lead is restored during charging. M. Reckenzaun of London expressed some doubts about these two forms of accumulators soon after the announcement of their invention was made. He pointed out that the deposits of zinc obtained in either case by the charging process were not of equal thickness over the entire surface of the electrode, thus producing ridges which in time reach the other electrode and establish short circuits. But even if this difficulty could be overcome, there still remains another objection. In every case, where chemical changes take place, changes of a physical nature also occur. The volume of bodies, undergoing chemical action, is also varying according to circum-

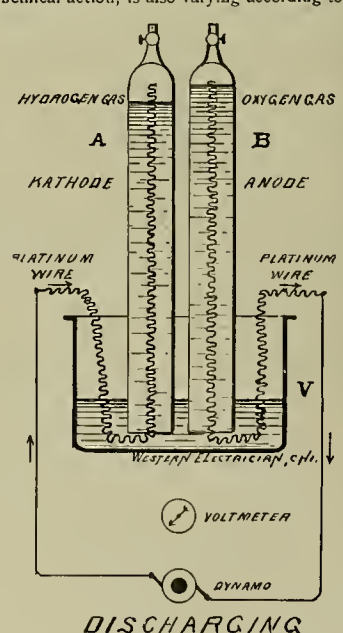

FIG. 2.—A THEORY OF ACCUMULATORS.

stances. Recall for example the expansion of the palladium wire during the absorbtion of hydrogen. The surface of the electrodes becomes "corroded," we may say, and in time, the corrosion penetrates the interior of the plate until all mechanical cohesion is destroyed and the plate crumbles into pieces, This is a well-known fact in relation to the positive electrodes of lead accumulators, but it is not a specific feature of the lead; but it takes place in every material and there is absolutely no reason to believe that one metal is better in this respect than another. Generally both copper and zinc plates are

subject to corrosion in the same manner as lead plates. There is no doubt that by the use of metals lighter than lead a high capacity of the cells may be obtained at considerably less weight; but in order to make such accumulators a commercial success the cost of the material and the manufacture must be the same or less for a certain output in ampere-hours. I do not believe that this has been accomplished yet and it is very doubtful whether a copper-zinc accumulator will ever fulfill these practical conditions. An iron accumulator may possibly supersede the old lead accumulator, but I have no fear this substitution will take place in the next ten years and disturb the manufacturer of the lead accumulators. I do not believe that the lead accumulator has yet reached its highest point of perfection in manufacture, neither do I think that our knowledge of the best methods of employing it is yet complete. I am convinced that the best efforts of electricians should be directed toward the perfection of the lead cell. Lead accumulators are doing good service now in many instances and it is to be hoped that the scope of their application will be greatly enlarged in the near future.

Sir Wm. Thomson and Electric Lighting.[1]

By George Westinghouse, Jr.

The article on "Electric Lighting and Public Safety," by Sir William Thomson, in the February number of the *North American Review*, possesses unusual interest by reason of its clear and forcible presentation of the precautions which have been adopted by the authorities in Great Britain to secure to the public the utmost possible degree of safety from electric currents conveyed by overhead conductors, and especially because it furnishes an adequate explanation of the unusual number of difficulties and fatalities which have occurred in connection with such conductors in the city of New York and in certain other localities, where the attempted municipal regulation of electric circuits has been of such a character as to aggravate tenfold the very evils it has been designed to remove. Of the points discussed in this article, the one which should receive the most careful attention at the present time, on account of its bearing upon the immediate future of the electric industries in the United States, is that which has reference to the recent action of the authorities in Great Britain concerning the granting of "provisional orders" to companies proposing to undertake the electric lighting of municipalities and municipal districts. It is only necessary for my purpose to quote his conclusion, which is as follows:

"It may be considered, indeed, as now definitely resolved that the distribution of electric energy for light and power in the towns of the United Kingdom shall be by underground conductors, and plans for carrying this into effect safely and economically are engaging the anxious consideration of electrical engineers."

An examination of the Board of Trade regulations appended to Sir William's article discloses one fact of controlling importance, and that is that not only must electric light and power conductors, even when safely and securely erected and perfectly maintained, be surrounded by costly safeguards, but every telegraph, telephone or other wire must be equally well protected, of course at a corresponding expense. In localities having an extensive network of these wires, an attempt to secure safety by the rigid enforcement of the Board of Trade regulations may well cause Sir William to remark that "the fulfilment of these rules can, indeed, be made practically certain. *But at what cost?*"

In view of the experience already had in this country, it may be taken for granted that no sane person would now undertake to erect aerial electric light and power wires in any locality in which telegraph or telephone wires were numerous, if compelled to comply strictly with the regulations of the Board of Trade. In fact, the evident determination of the authorities in Great Britain to virtually prohibit the use of aerial electric light and power wires in cities may be construed as a final determination that the problem of safe electrical distribution can be solved only by resorting to the use of underground conductors. One might almost go so far as to say that these regulations are in themselves sufficient, by rendering aerial electrical distribution in a commercial sense impossible, to do away with the necessity for their existence.

The enormous pecuniary damages which, in obedience to public clamor, have been inflicted upon those electric lighting companies in New York City having their conductors overhead, mainly because of ill-secured and abandoned telegraph and telephone wires, which persisted in falling down upon them, have sufficiently emphasized the fact that it is not worth while for any electric company doing business in that city to give further consideration to the problem of distribution for light and power service, other than by means of underground conductors. Hence it will appear that much remains to be done toward the solution of the real problem; the necessary regulations, and even in a great measure the considerations on which these are to be based, are yet to be formulated. Instead, therefore, of devoting further space to the discussion of the Board of Trade regulations, it would seem more desirable to consider how we may guard against some of the difficulties and dangers which are liable to occur in the distribution of electric light and power currents by means of underground mains; not unmindful of the fact that the constant march of improvement may render regulations which are ample and sufficient for to-day totally inadequate or even worse than useless for the conditions of to-morrow.

Before undertaking to frame specific regulations for guarding against the danger which is to be apprehended from electric currents traversing underground conductors, it is important to ascertain with as much accuracy as possible its character and extent. So far as concerns the consumers of electric energy in any form, or the general public, the danger may obviously be divided into two classes: First, the risk to persons from physical contact with a conductor charged with electricity at a high tension or pressure; and, second, the risk from fire originating from the heat-energy of the electric current under certain conditions. Concerning the first class Sir William Thomson says: "I may remark that 100 volts in a house is perfectly safe to the user, whether the current be alternating or continuous, as is proved by a large and varied experience in England;" hence the only precaution necessary to guard against injury is to prevent the possibility of contact with a conductor charged with a high-tension current.

Before proceeding to discuss the danger from fire, it is, perhaps, desirable to give the reader some idea of the difference in this respect between the behavior of the alternating and the continuous current. It is now quite generally understood that in the generation of electricity for electric lighting and similar purposes a coil of wire with united ends is caused to approach a magnet, by which operation a pulsation of electricity flowing in a definite direction is produced in the wire; and when the coil is withdrawn from the magnet, another similar pulsation is produced, but this time in the opposite direction. The repetition of this operation produces a succession of pulsations, alternating in direction, which is termed an alternating current; and in what is known as the alternating system of distribution these natural currents are used in the distributing mains directly, as they are produced by the generator. The production of what is known as a continuous current involves the changing of every alternate pulsation by a complicated mechanical contrivance called the commutator, which, through two sets of brushes—one set taking all of the positive currents, and the other all of the negative—causes the successive pulsations all to flow in the same direction, constituting what is technically termed a direct current and usually spoken of as a continuous current. This current is similar in character to that generated by the well-known chemical batteries.

Although the alternating current is really the natural current, and has been known as such for half a century, yet it is only within a very few years that the appliances for its utilization have been brought to sufficient perfection to be of practical utility, and it is only still more recently that its inherent advantages over the direct current for all purposes of electrical distribution are becoming recognized and appreciated. The fundamental and all-important advantage, in this respect, which the alternating current possesses over the direct current resides in the fact that an alternating current, when made to traverse a coil of wire, is capable of inducing or creating in an independent coil of wire in the neighborhood of the first coil a similar alternating current of equal energy, but capable of having its pressure or its quantity modified to any required extent—a result which the continuous current is utterly incapable of producing.

This important characteristic of the alternating current renders it possible to generate an electrical energy of any desired low pressure in a local system of conductors situated at any point, yet having no electrical connection of any character whatever, with the main conductors. By means of an apparatus known as a converter or transformer, which consists of little else than a mass of iron and copper inclosed in an iron box, the electrical energy traversing the main conductors is converted into magnetism—a perfectly inert and harmless form of energy, capable of producing neither heat nor shock, nor of being appreciated by any of our senses—and this is reconverted into electrical energy for local distribution. The interposition of this absolutely harmless form of energy as one link in the chain of effects secures, under proper and well-understood conditions, an absolute safety from fire, which it is impossible to obtain when the continuous current is used, for the reason that the latter necessarily involves an unbroken and direct electrical connection between the distributing and the consumption circuits. That the distribution of electricity by alternating currents of high tension, the transformation of the same by converters into low-tension currents, and the absolute disconnection of the two systems of conductors, are becoming generally recognized as features of controlling importance, is abundantly testified to by the almost universal adoption of these characteristics in the modern electric lighting plants in Great Britain, Continental Europe and South America, while in the United States more than four-fifths of the central station plants which have been erected during the past year are of the alternating system.

The recent distressing calamity in Washington, which resulted in the death of the wife and daughter of Secretary Tracy, again enforces the lesson that of all the dangers which confront us none are so imminent and none so difficult to guard against, as those which arise from fire; and it is scarcely necessary to say that the continual apprehension that a fire may originate at any moment from wires connected to underground electric mains, may become almost unbearable. We are but too frequently reminded of this danger by such occurrences as the recent destructive conflagration at Boston, which is believed to have resulted from an electric current, or other fires in New York City during the past few months due to the same cause, among which may be mentioned the sudden and complete destruction of the Pearl street electric-lighting station, which is understood to have been caused by an imperfection in the low-tension underground mains receiving their supply therefrom. These disasters, as well as the incident related in this *Review* by Mr. Edison, who stated that a contact between the mains of his underground circuits, at the corner of William and Wall streets, resulted in burning up the iron and copper of the conductors, and the reduction of the paving stones for several feet around to a molten mass, show that it has become imperatively necessary to reconsider and revise the present rules and regulations, and to adopt such new ones as may be found necessary to remove this omnipresent danger from fire caused by electric currents.

In considering this source of danger it should be borne in mind that electrical fires are results which are due directly to the quantity or volume, and not to the tension or pressure, of the current. The welding together of massive iron bars is quickly and perfectly accomplished with an electrical pressure of only one volt, although the volume of current is, of course, enormous. In the case cited by Mr. Edison, had the same electrical energy been conveyed at a pressure of 2,000 volts, instead of 110, no such destructive development of heat could have been possible; or had the mains of the system referred to by him been subdivided, instead of being interconnected into one enormous network similar to that of the gas-pipe system, the volume of current at any one point would have been wholly inadequate to produce effects like those described. It scarcely need be demonstrated that so long as vast systems of electric mains continue to be interconnected underground and all the electricity of low tension and great quantity that can be supplied by engines of 1,000 to 2,000 horse-power is poured into them, so long may we confidently expect from time to time these destructive conflagrations originating in underground conduits. No more effective plan to insure great destruction whenever a contact takes place between two wires could possibly be devised than the interconnection of all the mains, for the reason that it enables the aggregate energy of the whole station to be suddenly concentrated from every direction upon some one point; and this is equally true, whether the contact occurs in the street or within the walls of a building.

A very important, but little-understood, source of danger from fire arises from the leakage of current from underground mains, which is taken up by water or gas-pipes. Where the amount of wire interconnected is large, this leakage is sufficient to light a considerable number of lamps as effectively as if they were attached to the wires in the usual manner. If, therefore, any wire having a direct connection with an underground main is accidentally brought into contact with a gas or water-pipe, a fire may be instantly started in a place wholly concealed from observation: or if the electric wires are laid underneath a floor, and their insulation is defective at any point, even the solution of soap and water used in scrubbing may establish a path for the electric current, which will be followed in a few minutes by a well-developed fire. As the wires in buildings become older, their insulation is likely to become more and more defective, and with the lapse of time wires once well insulated, especially in situations in which inspection is difficult, will, when in connection with an imperfect system of distribution, become sources of danger.

It is conceded by all familiar with these matters that contact with a conductor charged with an electrical pressure of one hundred volts or less is not in the least dangerous to persons, whether the current be direct or alternating; but so far as the fire risk in buildings is concerned, it makes a vast difference whether a pressure of one hundred or of fifty volts is used. In experiments which have been made expressly to determine this difference, it was found that a fire could be easily started between two wires with one hundred volts of direct current by the moisture from such water as is commonly used for cleansing, while it was quite impossible to do so with a pressure of fifty volts of alternating current. It would, therefore, seem to follow from these considerations that the abandonment of the practice of connecting the street mains directly with the wires in buildings will remove at once and absolutely the most imminent fire-risk which otherwise is ever present; while by taking one step further, and reducing the pressure on the wires in buildings to, say, fifty volts, we shall so diminish the possibilities of the occurrence of a fire that there can no longer be any ground for the slightest apprehension on this score in the minds of those enjoying the benefits of the electric current supplied from underground mains.

The sufficiency of transformers or converters to absolutely prevent electrical connection between the street mains and the wires within buildings, has sometimes been questioned. An investigation has shown that in the converters constructed by some manufacturers the coil connected to the high-tension mains is wound upon a form of bobbin, and the second coil connected to the house wires is then wound directly upon this first coil. It is not strange that with converters of this construction contacts have sometimes been formed between the high-tension and low-tension wires, from which, at least in some instances, serious results have followed. In a properly-constructed converter a wholly different course is pursued; the two coils are wound separately upon separate forms, each layer of each coil being effectually insulated from all others, and when completed each coil is carefully wrapped with insulating material, after which they are placed in position, but at such a distance apart that it is impossible for the current to pass from one coil to the other, even if the insulation were not perfect. Many thousands of such converters have been put in use by the company which first introduced the alternating system in this country, and there has never yet been a single instance recorded of an accidental connection between the high and low-tension coil. All converters are, or should be, placed in fireproof situations at the point where the wires from the street main enter the building, and accessible only to authorized persons. Under these conditions it is evident that it will be impossible for any person within the building to come in contact with wires carrying a greater pressure than fifty or one hundred volts. It is scarcely necessary to point out that, so soon as the requirements for safety are fully understood, the use of insufficient and dangerous forms of converters or transformers will be prohibited.

One point which should not be overlooked, while considering the question of electrical distribution, is that with reference to the space now available in our city streets for underground work. One of the ducts in the subways as now constructed in New York city will accommodate a pair of wires capable of carrying, say, 100 amperes of current. If the pressure were to be limited to 200 volts, as some have proposed, such a pair of wires would supply in ordinary practice only 400 incandescent lamps, and those must be within a limited distance from the station; but if the pressure were to be increased to 2,000 volts, these same wires would supply no less than 4,000 incandescent lamps; and, moreover, these might be at a distance from the station many times greater. Hence with low-pressure current it

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will require at least ten ducts to provide for the same amount of lighting over a small area as could be effected with one duct at a pressure of 2,000 volts, and this is true even in an extensive distribution.

The immediate dangers from undergoun l conductors are of two kinds; one arising from contacts which may occur between the electric wires, and the other from explosions of gas which may accumulate within the manholes. The frequency of the first will depend upon the number of wires, or, speaking more accurately, upon the quantity of current carried; while the latter are more liable to occur where there are many conduits and manholes. It seems clear, therefore, if, by using high-tension currents the extent and area of the main conduits can be reduced to one-tenth of those required for low pressure, that there is every reason to expect that, when all the advantages are fully understood and appreciate1, the use of high-tension main current will be enforced purely from considerations of safety, without reference to economy.

Concerning the violent explosions of mixed air and gas in the subways and manholes, it has been observed in New York that they are quite as liable to occur in cases where the wires are used exclusively for the telegraph or telephone service, or for low-tension currents, as where they are used for high-tension currents. This is not surprising, as an explosive mixture will ignite quite as readily from a spark of half a volt as from 100 or 1,000 volts' pressure. Experience has shown, however, that no explosions have occurred when the manholes have been properly ventilated.

If electrical fires can be absolutely guarded against by a complete electrical separation between the street-main wires and those within buildings, with a limitation of the pressure in the last-named to fifty volts, and if such conditions can be readily complied with, may it not be advantageous to make those conditions compulsory? If conduits, subways, and even sections of street pavement can be destroyed by large quantity currents, ought not the quantity carried by each conductor to be limited? If the practice of interconnecting all the mains in a district is fraught with danger, ought not the practice to be abated? To these questions my answer is: The system of alternating currents and converters admits of these measures of safety,namely, an absolute electrical separation of the street mains from the wires in all buildings; the reduction of the pressure of the current to fifty volts within all buildings; the limitation of the quantity of current carried by street mains; the running of each pair directly from the station without interconnection in the streets, thus securing the highest degree of safety, irrespective of the economical advantages, which are neither few nor unimportant. It is much to be desired, in the interest of the public, that a thorough investigation of this whole subject should be made at the present time by competent and disinterested authorities. It is my own belief that such an investigation would lead to the adoption, among others, of regulations substantially as follows.

1. No direct electrical connection shall be permitted between street mains and wires within buildings, for either light or power.

2. The electrical pressure on the wires within buildings shall not be permitted to exceed one hundred volts.

3. Each pair of street mains shall be limited in load or volume to an amount not exceeding one hundred amperes, and every such wire shall be provided at the generating station with a device which will automatically disrupt the circuit in the event of a sudden increase above the authorized load.

4. Within buildings, the load for any one pair of wires shall not exceed that required to supply one hundred sixteen-candle-power lamps.

To these fundamental regulations it is, of course, apparent that many subsidiary ones must be added; but it is certain that such a system as that above outlined may be made to conform to such regulations as I have indicated, not without additional expense, but with a great and positive gain in economy, both in construction and operation.

Electricity as Applied to Street Railways.

By Nelson W. Perry, E. M.

I have read with great interest your report of Mr. Sprague's excellent paper, entitled, "Electricity as Applied to Street Railways," read before the recent convention at Kansas City. In fact, anything relating to this subject coming from his pen carries with it the weight of authority, and challenges the attention of electricians and others generally.

I remember once to have heard a most eminent physician quoted as saying that his life had been full of regret. During his earlier professional career it was a deep regret that the public in general, and his own patients in particular, had so little confidence in him as a physician, and the latter part of it that they had so much. Certain it is that success begets confidence and imposes upon the individual greater responsibilities, which he should not weigh too lightly. What I refer to is that while a careless or unweighed statement on the part of an individual unknown to fame may be condemned or passed without comment, it becomes of the greatest importance if made by a recognized authority. It becomes then capable of doing harm, and it then becomes the duty of those capable to correct the statement.

Mr. Sprague is quoted as authority for one or two statements in regard to the conflict between the telephone and the electric railroad interests that seem to me to require attention, for the simple reason that they were made by one of the recognized pioneers and leaders in the application of electrical science to the arts. With your permission and his I will point them out.

He says: "Now what are the facts? First, as I have stated, there is unquestionably an interference between the electric railway and the telephone service; but of the character of this interference, it seems to me that no *intelligent* man who *honestly* makes an investigation seeking after truth, and truth only, and not *biased by the commercial interests which have retained him*, can have any reasonable doubt. As a matter of fact, the trouble from *induction* is of the very *slightest* character, *and that must be patent* to any one who is familiar with this particular electrical action." The italics are mine. Mr. Sprague, while making his remarks general in character, is referring more particularly to the Cincinnati case which has but recently been decided. At the time that the Mount Auburn electric (Sprague system) commenced operations, I was employed by the City & Suburban Telegraph association of Cincinnati to investigate the alleged interference of the electric railroad with the Cincinnati telephone service. For the sake of argument, I am going to assume that I am fairly intelligent and moderately honest, and if you will grant these two premises I will make the statement that my conclusions do not in this case coincide with Mr. Sprague's.

One thing I found out, and that is that it is not safe to generalize, as Mr. Sprague has done. We cannot say that in one case either induction or conduction will be the predominating disturbing element until we have actually tested the case in question. This is so not because the nature of or laws governing induction are imperfectly understood, but because there may be many modifying causes that cannot certainly be predetermined either as to their existence or extent.

Had Mr. Sprague specified a particular case, and said that induction produced either chief or insignificant effects, I would not, with my present knowledge, think it safe for any one not having investigated the case in question to make any very positive contradiction; but when he speaks of the Cincinnati case, with which I am familiar, I am prepared to state that he would be wrong if he stated that *either* induction or conduction were the sole cause of the disturbance.

As there are a number of points of interest in this case which, as Mr. Sprague suggests, is likely to become a *cause celebre*, I will go somewhat into detail.

The Mount Auburn electric street railroad is a double-tracked road, about three miles in length. For about half its length, which we will call the Main street line, it runs through the business portion of the city, where the buildings form solid blocks, coming up flush with the sidewalk. This portion is generally quite level, though in crossing the canal a short, steep grade is encountered, and at another point there is a grade of several hundred feet, which at one point reaches 13 per cent. The other half runs chiefly through a suburban-like settlement, where the houses, chiefly residences, are considerable distances apart, and almost universally set far back from the street. This we will call the Mount Auburn line.

It is evident from the situations of the houses that the grounds in the Main street line are necessarily near the line of the railroad, while those on the Mount Auburn line are considerably removed. We would therefore expect much more disturbance from ground leakage on Main street than on Mount Auburn, but as the streets are of approximately the same width, we would expect about the same inductive effects in both cases. Since the electric cars ran for some time on Mount Auburn before they were started on Main street, my first experiments were made on the hill.

For the purpose of my experiments I had an ordinary telephone wire strung along the telephone poles for about half a mile, supported on glass insulators attached to brackets on the poles eight or ten feet above the ground and about twenty feet below the lowest line wires of the telephone company. Let us designate this extra wire as number 1.

A circuit was now made by grounding both ends of number 1. A telephone in circuit was very noisy, as was to be expected, when an electric car passed. Next, one of the telephone wires, about 35 feet above the street, was tapped and grounded at the terminus of the road. The noise was again very loud.

The next experiment was to make a complete metallic circuit by connecting number 1 and one of the regular telephone wires. In this circuit we had two wires, each half a mile long, connected together—a metallic circuit—but the two sides of this circuit were separated by a distance of about 20 feet. The day was fairly dry, and the two wires were as well insulated from the earth as is practicable in telephone line construction. Leakage, therefore, was practically eliminated; but as the outgoing and return wires, though parallel, were so far removed from each other that they must necessarily be unequally acted upon by inductive influences, I expected to hear noises due to this latter cause, and was not disappointed—in fact, they seemed to be quite as loud as in many of the telephones of complaining subscribers.

I next discarded wire number 1, and made a complete metallic circuit of the same length of two contiguous telephone wires. In this case the wires were not only parallel, but quite close together. If there had been faulty insulation to account for a part of the noises in the case where wire number 1 formed one side of the circuit, the same would hold in this case also, as the other wire was the same, and the circuit was of the same length and on the same poles. On the contrary, should the noises in the former case have been wholly due to unequal induction on the two sides of the circuit, they should very nearly disappear in this case because of the proximity of the two wires—and so I found it to be. The telephone was not, indeed, perfectly silent. Noises could still be heard of such a character as to be attributable, without doubt, to the electric cars, but they were unobtrusive—not sufficient to interfere materially with the use of the telephone, and not comparable at all with any of the telephones in use along the line of the railroad.

Now the McCluer device is one by which it is sought to remove the telephone ground to a point so far removed from the seat of disturbance that conduction currents cannot enter upon the telephone lines. It is not claimed by Mr. McCluer, nor is there any theoretical reason whatever for claiming that the McCluer device can or will abate in any way disturbances due wholly to induction.

A telephone subscriber located at a considerable distance, say a mile or two, from the electric railroad, will, if his telephone have a ground at that point, enjoy the fullest benefits of the McCluer device. As many of the telephone lines running parallel with the electric railroad extended to this distance, and in some cases to much greater distances from the line of the railway, and were still exceedingly noisy, I thought it not worth the while to attempt an experiment with a specially prepared McCluer wire. In fact, as *four* of the wires extended to Hamilton, Butler county, Ohio, a distance of not less than 17 miles beyond the terminus of the railroad, and were still exceedingly noisy, I would have had to go a long distance, indeed, to have found a better point to ground my wire. It was proof conclusive that the McCluer device would *do no good* in that particular case.

I also demonstrated another point that I did not know before, but which, it seems, was known to others more familiar with the subject than I, and which afterward came out in the expert testimony at the trial, viz., that two quiet circuits, when united into one, may become quite noisy.

At a point beyond the terminus of the railroad I cut one of these four wires running to Hamilton. The part running to Hamilton, being removed from the railroad, was of course quiet; but the part running into the Cincinnati telephone exchange, a distance of about three miles, was noisy. Since both of the grounds were removed from the railroad, this noise was due solely to induction. Over this noisy wire I called up the exchange, and had them connect me with Hamilton by another parallel wire. Now, from the point where I tapped the wires, both of them going toward Cincinnati were noisy if taken separately, but almost perfectly quiet if forming the two sides of the same circuit; also the wire running from me to Hamilton was perfectly quiet, because it was nowhere near enough to the railroad to be affected; but when I connected these two silent wires the noise was immediately reintroduced. In other words, by adding about 17 miles of perfectly quiet wire to another circuit of 6 miles that was quiet, because of the balanced induction, the whole 23 miles became noisy—were thrown out of balance, as electricians say.

Now since many of these telephones, far removed from the line of the railroad, were quite as noisy as any of those in its immediate vicinity, and as there was no complaint of false calls in the latter, there seemed no use in putting up a McCluer wire to abate conduction, which was manifestly an unimportant disturbing element on Mount Auburn.

But I was very much mystified by the difference in degree to which telephones seemingly similarly situated were affected. Every rule and probability seemed to be set at defiance. As I have said, some telephones, whose grounds were furthest removed from the railroad, were noisier than some whose grounds were nearer to it. A telephone whose wire ran parallel with the road for a quarter of a mile was sometimes noisier than one whose wire ran parallel for half a mile; but what was more perplexing, it was not always the case. Two telephones, whose wires were parallel for equal distances, were usually affected to perceptibly and often markedly different degrees.

Sometimes, of two telephones leaving the street at the same pole, the one going east was the worst, at others that going to the west gave most trouble. Sometimes it was the one whose earth connection was in high ground, sometimes it was the one that ran into low ground that responded the loudest. Whether the circuit was completed through made ground—newly made or well settled, or whether it was through the undisturbed virgin soil, whether it were made by gas or water pipes or by other means—no law could be discovered or suggested that might not be violated by the next telephone inspected. Indeed this question of what caused the very great variation of disturbance in neighboring telephones on Mt. Auburn was one that perplexed me for a long time. At last a fortuitous circumstance led to its solution.

By an arrangement with the telephone company the police and fire departments use for their own purposes the tops of all the telephone poles that are necessary. I had noticed, in listening to the various telephones in the disturbed district that the instruments in the Corryville police station and fire engine house—both on the line of the Mt. Auburn electric railroad—were unusually free from disturbance. At first it occurred to me that this was due to their being, from their position on the pole, further removed from the inducing current, but subsequent investigation developed other wires quite as favorably located as far as distance was concerned, but which were very much more noisy.

Another solution must therefore be sought, and I noticed then that in the latter case there were never many wires between the disturbed wire and the trolley wire, whereas in the case of the fire department and police wires, there were perhaps forty or fifty wires below them. With this hint that the disturbance was due less to the absolute distance than to the relative distance, I made another round of Mt. Auburn, tracing up and locating exactly the relative positions of the various wires on the poles, and in every case I found that the wires on the lower cross arms of the street side of the telephone poles, where the screening effect of other wires was absent, were the loudest, as those so situated as to have many wires between them and the trolley wire, were quieter and seemed to be relieved in proportion to the number of intervening wires which seemed to act as a screen. In fact, so invariably was this found to be the case that by noting the position of the wire on the pole relative to the others, I could tell with almost absolute certainty what would be the condition of the telephone to which it led.

I thought for a while I had found one marked exception to this rule. There are two drugstores on the opposite sides of a street intersecting the one on which the Mt. Auburn street railroad runs. I predicted that the telephones in both of the drugstores would be found very loud, but examination showed that while one was very noisy the other was perfectly quiet. I could not account for the silent one at all—they were both directly on the

line of the electric railroad and both made their earth connection by means of the gas pipes, and yet one was perfectly silent. In tracing up the wires again that led to the telephones I found that while in the case of the noisy one I had gotten the right wire when I made my prediction; in the case of the quiet telephone I had been mistaken, and that it was connected with the exchange by an entirely different wire, that came up the intersecting street, and which at no place was parallel with the electric railroad. Since the ground connections of these two were equally near the electric railroad, if leakage were the prime cause of the disturbance it would have been equally active with both. Since it was not, we must conclude, especially since the noisy wire was parallel with the road for a considerable distance, and the quiet one was nowhere parallel, that conduction not only had nothing to do with the case, but that induction had everything to do. There were many other experiments too numerous to mention here that seemed to point incontrovertibly to the conclusion that the trouble on the wires leading through Mt. Auburn and beyond was in almost every case almost wholly due to induction, and as such could not be obviated or mitigated by the McCluer or any other similar device.

In the city, however, on the Main street line, we find a different state of affairs. There the bells would ring and the annunciators in the exchange would frequently drop on the passing of a car. Here was evidently a case of trouble by conduction or leakage and an instance where, as the doctors would say, the McCluer device was indicated. Mr. Robinson, the efficient superintendent of construction of the Telephone company, thereupon put in a McCluer device, carrying it down to the Ohio river for a ground connection. He tells me this entirely remedied the trouble from leakege, and what was to me at first surprising, left the service of the telephones along Main and Walnut streets in much better condition than the best of those on Mt. Auburn. Since the wires were not further removed from the cause of disturbance than those on Mt. Auburn, and were not in any perceptible way more effectually screened, I had expected that they would at least be equally affected by induction. That they were not however, was evident. My explanation of this, is that the effect of static induction came in as a mollifying agent in this way:

As the current passing along the trolley wire varied in strength, it would induce on the parallel telephone wires a varying static charge of opposite sign to its own. I should not be at all surprised if this static induction played as important a part, or nearly so, in telephonic disturbance, as the dynamic induction. Now in the city where the house roofs are as high or higher than the telephone wires, they would be statically charged also with a sign of the same kind as the static charge of the telephone wire, and the opposite to the trolley wire, and being of the same sign as that of the telephone wire would tend to induce in the latter a charge of the *opposite* sign, or in other words to *undo* the static effect of the trolley wire upon the telephone wire—hence the notably lessened effect by induction on the Main street line. On Mt. Auburn this reflected effect must be wanting because of the paucity of houses and their much greater distance from the inducing wire; hence we have here what at first sight, might appear to be a lessening of inductive effects by an instrument (the McCluer device) that can from the nature of its employment have absolutely no such effect.

I think it is evident from the foregoing that in the case in question, it is highly improper to lay the whole or even a large part of the blame exclusively to either induction or conduction. I think on the contrary, it would be perfectly proper to say that on Mt. Auburn and beyond, the trouble is almost wholly due to induction, whereas on the Main street line one could with almost equal propriety say that it was largely due to conduction or leakage

Mr. Sprague argues that the induction cannot become prominent, because the wires are not nearer than from 20 to 30 or 40 feet, and seldom parallel for distances greater than two or three miles. One of my experiments shows that if they are parallel for half a mile at this distance, the disturbance is quite marked. And furthermore there are several patents that have met with more or less success experimentally, for telegraphing to and from moving trains. This is accomplished in exactly the same way as the telephonic troubles under discussion are caused, and in such appliances of the principle of induction the length of parallelism is not two or three miles, but limited *to the length of a single railroad car*, or at most to the length of a railroad train.

I think he must admit this point is not well taken.

He furthermore says: "The current used upon this wire (the trolley wire) is not of that character which distinguishes some of the arc light circuits, but is of more or less even flow, and the abrupt and large changes due to change of load on the motor are comparatively infrequent. There is a very small change due to the variation of resistance of the armature of the motor, because of the different relative positions of the commutator blocks under the brushes, and there is likewise a variation due to the slight but rapid changes of counter electromotive force set up by the motor when running."

I suppose in speaking of the arc light currents he is referring to those generated by dynamos of the Brush and Thomson-Houston type which have but few commutator segments and compares them with that derived from the Edison type of armature with many commutator segments, but since in the two former types the currents of the several neighboring coils lap over each other, and in the latter they practically do not lap at all, in the same sense, I apprehend the musical tone due to one type would not be materially louder but materially lower than that due to the other. Nor do I imagine that the varying load or the varying counter electromotive force, the change of speed or starting or stopping of the electric car has any material effect upon the telephone. The variation in current due to such causes is many times too slow to produce an audible sound, but I do think it is largely due to the very rapid and inevitable changes of current due to the varying contact between the wheel and the dirty track over which it is rapidly moving, and in case the electrical connection between the motor and the track be by means of the gear, by the unavoidable variation of contacts between these parts.

Practical Working of the Electrical Subways of New York City.[1]

By William Maver, Jr.

Part II.

ELECTRIC LIGHT CABLES IN SUBWAYS.

In the electric light service in the subways, and I am aware that it is around this that the greatest interest centers, there are, exclusive of the Edison system, four different types of insulation used—namely, the Bishop rubber compound, the Standard underground cable, the Safety insulated, and the Cobb vulcanite-paraffine cable. All of these cables are lead-covered as a precaution against mechanical injury, action of acids, etc., or moisture.

The sizes of conductors used in the electric light service vary with every company and with the character of the service: for feeders, the conductors range in size from No. 000000 B. & S. to No. 2 B. & S.; for mains, from No. 2 to No. 6 B. & S. In many instances No. 10 B. & S. is used for connecting from the mains to lamps through the subsidiary ducts.

THE STANDARD UNDERGROUND CABLE.

The insulation of the Standard underground cable is obtained by first wrapping thick cotton thread or cord around the wire, to any desired thickness. The wire thus covered is then placed in a cauldron of boiling insulating compound—a product of petroleum. This treatment displaces any moisture that may be in the cotton thread. After the cotton has been thoroughly saturated with the compound, the whole is then lead-covered. Care is of course taken by soldering up the ends of the cable to prevent absorption of moisture in shipment, and in drawing into the ducts.

There are now in actual service for electric lighting purposes in the New York subways over 95 miles of this cable, carrying currents of an e. m. f. of from 300 to 3,000 volts, including many 1,000 volt alternating currents, and an additional 50 miles of the same cable will shortly be in operation. The thickness of insulation used in these cables is $\frac{5}{32}$, $\frac{6}{32}$ and $\frac{7}{32}$ of an inch. This refers to the thickness of the insulation from any given point of the circumference of the conductor.

THE SAFETY CABLE.

The insulating material of the Safety insulated cable is an India rubber compound. It differs somewhat, I believe, from the ordinary run of India rubber compound cables, in that the compound is placed over the wire without seams or laps of any kind. This compound is vulcanized to a moderate degree of hardness sufficient to prevent decentering of the heavy conductors which it insulates, but yet it retains a high degree of flexibility.

The thickness of insulation used in No. 4 Brown & Sharpe wire, .204 inch diameter, is .108 inch. The weight of this conductor, lead-covered, is 4,861 lbs. per mile Of this the wire weighs 665 lbs., the insulation 669 lbs., the tape 95 lbs, the lead covering 3,432 lbs.

A special thickness of this insulation was made in one instance in response to a call for cable to withstand a strain of 7,000 volts for arc lighting. The thickness of the insulation is .238 inch. The conductor is No. 4 B. & S. gauge. This cable is now in the subways. Its length is about three miles. I am not aware that it has yet been called upon to withstand the prescribed 7,000 volts.

There are now over 65 miles of the Safety cable in actual use in the subways assigned to electric light circuits carrying continuous and alternating currents of from 1,000 to 2,500 volts e. m. f., and about 15 miles additional are now being placed in subways.

THE BISHOP RUBBER COMPOUND CABLE.

The Bishop rubber compound cable is of the well-known Silvertown type, having first a coat of rubber without sulphur; then a coat of rubber compound with sulphur, and over this a lapping of rubber cable, which is then taped. There are two sizes of this cable in the subways, namely, No. 4 B. & S. and No. 6 B. & S. The thickness of the insulation is 4-32 inch; the thickness of the lead covering is 5-64 of an inch; the outside diameter of the cable is .65 of an inch, and the weight of the cable is about 3,432 lbs. per mile. There are of this cable in successful operation about 10 miles assigned to alternating currents of 1,000 volts, and 5 miles to arc circuits of 2,500 to 3,000 volts e. m. f. Double this amount of this cable will soon be laid for a similar purpose.

The Cobb vulcanite-paraffine cable is of a somewhat unique construction and design. It also materially differs, in one respect, from the other cables described, in that the conductor is freely movable within its insulating medium. The cable is made in practically the following manner: A vulcanite tube is first made in lengths of about 300 feet. This tube is moderately flexible. The tubing is vulcanized in boiling paraffine. The wire is then threaded through the tube, after which the sections of tubing are joined together. A thick cord is then wound spirally around the vulcanite tube. The whole is then lead-covered, and the space between the vulcanite and lead formed by the spirally wound cord is filled with paraffine.

There are about 25 miles of this cable in the subways. In the case of the Bishop, Safety, Cobb and Patterson cables, the lead is alloyed with about 3 per cent. of tin. The lead covering of the Standard underground cable is unalloyed, but it is covered with a thick cotton braiding soaked in P. & B. paint (the latter a product of petroleum), which, it is claimed, will protect the lead from acid gases, etc., and the braid also acts to protect the lead from mechanical injury.

CONDITION OF THE CABLES.

I may say that all of these cables are guaranteed by the manufacturers for three years. This term, however, is not to be taken as signifying the limit placed upon the life of the cables by the manufacturers.

It is over a year since current was turned on the first high tension electric light circuit in the New York subways. This was a circuit in One Hundred and Twenty-fifth street, belonging to the Harlem Electric Light company. The insulation resistance of the cable, as measured just before the turning on of the current, showed it to be 1,750 megohms per mile. A test made of the same circuit last week, after one year's continuous service, showed it to have an insulation resistance of 1,516 megohms per mile. Since the installation of the circuit just referred to, electric light cables of the various types described have been drawn into the subways almost as rapidly as they could be manufactured, and tests made of the conductors months after the initial test, have shown them to be in the same electrical condition as when first laid.

There have been several burn-outs in cables in the subways within the year, but with the exception of an abandoned type of cable, to which I shall refer later, these burn-outs have been traceable in every case to defective joints or to mechanical injury. In all, according to the records and best obtainable information, there have been, exclusive of those in the abandoned cable, but five burn-outs in over 185 miles of electric light wire during a period of active service of the conductors ranging from one month to thirteen months.

In the case of 27 out of 34 of the electric light circuits in the subways not a single defect of any kind has occurred since they were placed in the ducts.

There have been several instances when faults not amounting to burn-outs have been discovered by the regular tests, which have brought the insulation resistance of certain conductors below the requirements of the rules of the subway, but these defects have generally been located and removed without serious delay to the circuits. Where this has not been the case, it can be fairly attributed to the employment of untried insulation, unfamiliarity with underground service, or to the inexperience of the men to whom the work of connecting up circuits, etc., has been intrusted. For instance, in a number of cases grounds have been traced to contact of the conductor with the lead covering, and the linemen so connecting them have explained that they were not aware the lead covering would cause a ground.

On several occasions grounds have been caused by the driving of nails through the lead covering of the cables or leading-in wires, under the moulding inside of buildings, and on another occasion a ground was caused by a laborer's pickaxe while excavating for a new subway which crossed an existing subway. It is related of the laborer that when he saw the smoke arising from the burning insulation, he first tried to put out the fire by throwing water over the cable, and subsequently by throwing wet mortar around it.

It is perhaps not remarkable, in view of all the circumstances, that anything in the shape of an electric wire is looked upon by outsiders with serious apprehensions. It has sometimes been amusing to notice the wide berth given even the leading-in wires used during the making of tests of cables by the occupants of buildings from which the test is being made.

On one occasion, while a test was being made in the basement of the Hotel Brunswick, it happened that the lead wires were lying on the floor, near by a small pool of water in a hallway. A servant, seeing the water and the wires in close proximity, called out in alarm to one of her companions who was approaching, "Take care, Mary, the electricity is running out!"

DEFECTIVE CABLES.

In the case of the cable previously referred to as having been abandoned, the burn-outs were of almost nightly occurrence. The delays to the company using this cable were necessarily vexatious, and I may say that in my references to burn-outs, defects, etc., occurring in underground cables, I have not included those that were due to the use of this evidently inherently defective cable. This was a lead-covered cable, with a vulcanite tube as an insulating medium. This special type of cable has been abandoned and is no longer in service in the subways. What may appear a singular feature in connection with the burn-outs in this cable was the fact that the cable had a higher apparent insulation resistance than any other cable in the subways, and would frequently, on a test, show an insulation resistance of over 4,000 megohms per mile a few hours before the occurrence of a burn-out. The same cable showed even a higher test at the factory, namely, about 20,000 megohms per mile. In the latter case it was tested with 400 volts. Burn-outs on this cable have occurred when the pressure employed on the circuit did not exceed 600 volts.

The explanation of this may be that, owing to the nature of the insulating material, and to the fact that it was not tested under water before being lead-covered, there may have existed fractures in the vulcanite tubing, or such fractures may have been caused in process of drawing the cable into the ducts. Under the tests made with the 100 and 400 volts e. m. f. of the testing battery, the fault would not develop; while under the high electromotive force of the dynamo and the current of 10 or 12 amperes the fault would develop perhaps as a result of moisture, of condensation of the air in the tube caused by the heating of the wire. This explanation is apparently confirmed by the fact that 25 miles of a somewhat similar cable—namely, the Cobb cable, which I have described, but in which paraffine is placed between the lead covering and the vulcanite tube—has been in operation in the subways for high tension currents for over two months without any indication of a defect having occurred.

It was rather unfortunate that the cable which I have said has been abandoned as unsatisfactory, and which has indeed been withdrawn from the subways, appears to have been the only type of cable used for electric lighting purposes in the New York subways which came to the notice

[1] Read before the American Institute of Electrical Engineers.

of an English electrical engineer during a flying visit to this country, and a description of which cable he presented to our sister society in London in a recent paper, with a favorable prediction as to its probable success.

LOCATING FAULTS.

The method employed for locating faults in electric light conductors in the subways is to test the conductor from point to point until the defect is placed between two lamps or manholes. When a fault is located between two lamps or two manholes, if it is in the cable proper and not in a joint at a hand-hole or box, the defective section is withdrawn and a perfect section put in its place. With the exception of the hard rubber cable referred to, this has, I believe, been necessary but on three occasions after current has been turned on the circuit. In two of these the defects were caused by improperly made joints. In the other case by a mechanical injury.

In the case of arc lights or series circuits, defects in the cables are more readily located than in multiple arc circuits, because of the facility afforded by the openings at the lamps for testing the conductor in sections. In the case of multiple arc circuits there is at present no means of locating faults but by cutting the conductor in manholes. For as the house connections are made from the cable by T joints, it is obvious that the only effect of disconnecting the lamps or converters from the cable is to separate the two conductors of the circuit. These remarks, it is understood, do not apply to the Edison conductors, to which, it is well known, access is had at the ends of each pipe by removing the paving and earth.

No attempt is made to locate faults in electric light circuits in the subways by electrical measurements, for the reason that the obstacles in the way of obtaining accurate data are so numerous that it has not been considered expedient to rely on the results of such measurements. For instance, the uncertainty as to the distribution of the resistance of the conductor, owing to the numerous joints in the circuit; the variations in temperature of the subways and the difficulty in ascertaining it, etc.

To facilitate locating of faults, should they occur in the subways, several forms of accessible joints have been suggested for use in the manholes. One of these, known, I think, as the Dillon joint, consists of a metal cup, having in its bottom apertures through which the cable ends pass. The lead covering of the cable is soldered into the cup; the conductors are connected or spliced and insulated, when a water tight cover is screwed over the cup.

Another accessible joint, known as the Cobb joint, is made as follows: A copper disk is soldered on the ends of the conductors to be connected. Over the disk a vulcanite sleeve is placed. Two shoulders, having respectively a right and left-hand screw, are placed near the sleeve, over the insulation of the conductor. The sleeve is provided with a right and left-hand thread. The forward movement of the shoulders is checked by disks on the ends of the conductors. Thus, when the sleeve is screwed on to both shoulders, the tendency is to press the two disks together tightly. This joint can be made very quickly; but as to its practical utility, it is not possible to speak definitely as yet, since it has not been in actual service in the subways, so far as I am aware. The same is true of the Dillon joint.

It is perhaps a debatable question whether easily accessible joints are desirable in the manholes of subways, as the tendency in such cases might be to lead to accidents by the exposure of live wires.

DURABILITY OF CABLES.

Concerning the much discussed question as to the relative durability of rubber compound and fibrous cables, I do not think sufficient time has elapsed in the case of the cables in the New York subways to enable one to arrive at a definite judgment. In the case of both types of cable, as I have already said, many circuits have been running continuously for over nine months, and in some instances for over one year, without a defect of any kind, electrical or mechanical, having occurred, and the slighter defects that have occurred on other circuits have as yet been so few in either type of cable as not to certainly show any marked superiority of one type over another. Specimens of cable that have been examined after nine to twelve months' service show no physical or electrical signs of deterioration of the insulation.

As regards the question as to which kind of cable will best withstand the heat from steam pipes adjacent to the subways, it would appear thus far that the lead-covered, fibrous cable is superior to the homogeneous cable *not* lead covered. Lead-covered rubber compound cables have not as yet been tried in the heated districts.

MULTIPLE CABLES.

There are no concentric cables in the subways in this city. The mains of multiple arc circuits are operated in separate lead covers in the same duct. It is contemplated, I believe, by some of the companies to use one lead cover for such circuits hereafter. One objection on the part of the companies to the use of concentric cables is the anticipated difficulty in making joints, especially where frequent connections for distribution are required. This objection should not hold good in the case of the feeder portion of the circuits.

As to the use of multiple cables for electric lighting: One such cable—a fibrous cable—having eight conductors under one lead cover, was placed in the subways, but has not been operated as yet, trouble having been found in making perfect joints. I have no doubt that with the experience since had in joint making this difficulty would be overcome, but it seems to be the general opinion that the use of multiple cables is not advisable in electric lighting.

On the subject of loss due to increased electrostatic capacity, or to increased self-induction of conductors in the subways, I may say that I have made careful inquiry of superintendents of stations where the alternating current is used, and learn that no perceptible difference in the operation of the circuits, as compared with similar circuits overhead, is noticeable. I have been informed that in wet, stormy weather a decided improvement is observable—in fact, that the condition of the weather does not affect the circuit. This will be readily understood when it is stated that a recent test, made during the prevalence of a drenching rainstorm, of an arc circuit in the subways, four miles in length, showed an insulation resistance of 2,400 megohms per mile. The lamp connections were disconnected from the cable proper during the tests, so that the entire cable was under cover, except at the pole.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 1.—The Senate committee on general laws which is now investigating the several systems of electric lighting and power, as employed in the cities and towns throughout the state, is engaged taking testimony at the Hotel Metropole. When the committee reports to the senate in April such recommendations for public safety as they have concluded upon, it is hoped that any future legislation may be founded upon unbiased and impartial judgment. Last Monday ex-Commissioner Gibbens gave his experience as a member of the Board of Electrical Control. He thinks that good construction underground and good insulation will prevent all danger in the use of high or low tension currents, and that the subway companies and the electric lighting companies are in a position to provide such construction.

The much argued Kemmler case came up in the Court of Appeals at Albany this week. While this is nominally an appeal from an order dismissing a writ of *habeas corpus* obtained by Kemmler, it involves the whole question of the constitutionality of electrical execution. W. Bourke Cochran in his appeal for Kemmler argued that the proposed penalty was unconstitutional, as no man knows the exact amount of current required to cause death, and this lack of knowledge would necessarily subject his client to torture. He continued: "Constitutional inhibition of cruel or unusual punishment renders any law passed by the legislature in violation of its provisions unconstitutional and void. Public policy and the security of the constitutional system alike demand the enforcement of this provision by the judicial department of the government. It will be conceded that the infliction of the penalty will expose the relator to the risk of torture. The sentence is in violation of the constitution, and therefore void. It is unconstitutional because upon its face it provides for the infliction of an unusual penalty." Attorney-General Tabor presented the following points: The appeal to constitutional prohibition must be ineffectual because such prohibition is not intended to act against legislative action. The only question that can be gone into on the return of the writ is as to the jurisdiction of the court that pronounced the judgment. Even conceding that the testimony taken was competent on the question of constitutionality, the evidence so far from indicating that the infliction of the death penalty by electricity would be cruel, demonstrates that such method will be certain, painless and instantaneous. Both the county judge and the general term have so held. Opinions of famous electrical experts show that such a death is not cruel—in fact, not nearly so cruel as hanging. If execution by this means is unconstitutional, then death by hanging or any other means must be unconstitutional. The whole question was upon constitutionality, and if the law was found constitutional the man must be executed by electricity. Briefs were also presented in the case of Kemmler's appeal for a new trial.

The dense fog which settled over New York last Tuesday night gave Dwight Wiman an opportunity to display the superiority of the electric search light he has invented. So great was the fog that it was impenetrable to the ordinary arc and incandescent lamps that on ordinary occasions illuminate the ferry slips. An ingenious adaptation of this light to the use of navigators has been made on the Sound steamer Rhode Island. The light is located on top of the pilot house, and is connected with the regular incandescent system of the boat as is also the steam fog horn, and both of these are operated from the pilot house through a combination of switches. It is thought that this system when fully developed will remove all danger of collision at sea. It is proposed, when the experiments are satisfactorily concluded, to place these lights on the ferry slips. With the beams thrown vertically the pilots will be able to approach without being blinded by the glare, and yet the vertical beam of light will be as plainly seen in the fog as an ordinary lamp is on a clear night.

William E. Lewis, superintendent of telegraph on the Long Island railroad, has issued an order directing operators on this road to withdraw from the Order of Railway Telegraphers. Two officials of the order who were employed under Mr. Lewis were removed last week, and this action has raised a storm of indignant protests from all over the country. The organization is generally favored by railway companies, as it is opposed to strikes and admits only reliable operators; in fact, on many roads no applicant for a position is considered unless he can show that he is in good standing in the order, though the organization has never advocated such a measure. Mr. Lewis based his objection to the order on the ground that its members refused to act as instructors to boys whom Mr. Lewis desired to place in his office, and eventually install in the positions now held by the older members. The representative of the order says: "We intend in the event of trouble to simply allow our men to come to us to be placed elsewhere, leaving it for the company and the travelling public to contend with the 'scrub oak' element. If they are content to put up with cheap labor and possibly a few fatal accidents and 'bulled' business generally, we are satisfied to let them. If competent men are required they can be had from among the members in good standing of our organization. If men would occupy their spare time in practising and becoming adepts at their work in place of teaching students for the paltry sum received for such services and recommending them for duty before they can copy an order correctly or know how to operate a semaphore, many of the wrecks that have occurred would have been averted. It seems to me that the sooner an order is recognized by the railway officials of this country, and none but its members hold positions on their lines, the quicker accidents will cease."

Secretary Moss, of the Board of Electrical Control, reported to Mayor Grant that the Western Union Telegraph company and the Fire Department were making rapid headway in removing poles and wires. Since their last report 68 poles and 98 miles of wire have been taken down.

An adjourned meeting of the Board of Electrical Control will be held next Monday, and the subway contract it is likely will be awarded. The fight over the subway is delaying the extension of electric lighting, and a speedy settlement of the differences ought to be made, so that the city may be properly lighted.

The Electrical Accumulator company has been denied the patent calling for a combination of motor and storage batteries for street-car propulsion, but the original Faure patents are not affected by this decision.

The syndicate which purchased the Newark surface railways at the enormous figure of $3,400,000 proposes to equip all the lines with overhead system of electric propulsion. Now that the value of the property is known, the city proposes to realize about $50,000 more tax, as the valuation last year was only $900,000.

Commissioner Gilroy has decided that the injunction restraining the Board of Electrical Control from awarding the subway contract to the Standard Electrical Subway company shall not interfere with his work of repaving the streets, and work will begin March 15.

The Commonwealth club, at the last meeting, discussed "The Construction and Care of Streets." Commissioner Gilroy, in his speech, said: "I confess I am very despondent about our streets. In the matter of electric subways there is bound to be annoyance, for in every twenty-five feet along the subway there is an armhole for making connections with buildings; and after the subway is constructed and the pavement relaid, it will be in order for the corporation controlling it to tear up the pavement at every armhole if the tenant of the building desires to put in an electric light. We cannot be secure in our streets until the laws are radically changed."

Probably the largest concourse of people which the New York Electrical society has ever gotten together listened to a paper by M. J. Sullivan on "An Evening with the Edison Phonograph." The illustrations of the recording and reproducing power of the phonograph were varied and amusing, and the whole performance a most effective one.

The Sawyer-Man Electric company is mentioned in the last official report of the United States navy in the most highly complimentary way for the superiority of its incandescent lamps. The report says that the lamps have an average life of from 5,000 to 7,000 hours on both the Omaha and Atlanta steamships, and that this exceedingly long life of lamps is certainly unusual.

The Peckham Street-Car Wheel & Axle company have lately secured the exclusive right to use the Meneely rolling bearings. These bearings save all lubrication, and it is said that a car fitted with them can be moved upon a level track with less than one-fourth the power required for ordinary bearings.

St. Louis, Mo.

ST. LOUIS, March 1.—An interesting incident is recalled by the action of the Board of Public Improvements in calling Chas. Sutter to account for failing to comply with the terms of his agreement with the city. It will be remembered by all who were interested in the contest at the time that Sutter when awarded the contract for city lighting, announced his intention of installing a low tension system. He convinced

the city officials intrusted with the supervision of the plans that a low tension system was just what was needed in St. Louis—he might have convinced them with equal facility of the advisability of putting in high tension machines, as they know absolutely nothing of the relative merits of the systems. Sutter accordingly proceeded to award the contract for the lights to a low tension company, but before the lamps and machines were completed the company was absorbed by a larger corporation, and the manufacture of the style of apparatus which Sutter ordered for St. Louis was discontinued. A high tension system was substituted, but when the rivals of Sutter learned this they raised such a howl that it awakened the city officials, and Sutter was called to account. When he appeared before the board he proceeded to extol the merits of the high tension system substituted for the discarded low tension machines to the amazement of everybody. He asserted that he had new light on the subject, and left the board completely bewildered. It is quite possible that there will be considerable legal quibbling before the question is finally settled.

The Pacific Mutual Telegraph company has filed its list of taxable property in the office of the city register, placing the amount of the telegraph company's taxable property at $630 for poles and wires. The Postal Telegraph company's list places the amount of that company's taxable property at $1,735.

E. P. Vail, of the Edison-Sprague company, visited St. Louis this week to consult with the local representative, Mr. Guernsey.

The St. Louis Electric Power company has installed two Russell engines and two Edison 80,000 Watt dynamos in its new station on Morgan street, between Second and Third. The machines and engines in the old building, recently destroyed by fire, have been repaired and placed in position in the new structure. The company is now supplying power for 60 electric motors ranging from 1 to 20 horse power.

The Missouri Electric Lighting company reports a loss during the past month of $150, caused by boys throwing stones at and breaking the glass globes of their lamps in alleys. Mayor Noonan declares that he will show no clemency if they are captured. O.

Louisville, Ky.

LOUISVILLE, February 27. — The report of Charles Smith, the Louisville manager of the Western Union, recently appointed electric light inspector, has created somewhat of a sensation. He calls especial attention to the matter of insulation, and says that, where the wires have been in use for some time, they are virtually unprotected by insulating material. He directs attention to the manner in which the wires are strung in the open streets, and states it is possible for accidents to occur, as there are a great number of all kinds of wires crossing each other in close proximity. Wires, he says, are sagging over signs, and in some cases are attached to awnings without proper insulation. "The wires now being put up are in most part, at least, reasonably insulated," says Inspector Smith in his report, "the insulation material covering them being generally moisture proof and reasonably durable, though very little of it is of the highest grade. All are protected by servings of cotton braid, the braid being put on to protect the insulating material that is put on next to the wire to hold the substance used by absorption. The composition of these various insulating materials is not generally known beyond the factories that supply them. All probably embrace in their composition parts more or less of rubber, some resin, more or less of animal oil, coal tar, and coal products. All of such insulation is only medium in quality—the recognized high grade materials, such as kerite, okonite and similar substances, are little used for outdoor work here, and not generally anywhere, because of the relatively high cost, the price being such as to make their extensive use for outside purposes prohibitory." The report goes on to say that the insulating material in use here is that generally used, though it is not nearly as safe as the costlier material; that no insulation is proof against the effects of the change of weather, which soon causes decay; that there is danger in defective manufacture, accidental abrasions and unprotected joinings. The majority of wires do not carry dangerous currents, "but," he says, "some are without question dangerous as a rule. Those that appear the least harmful are the most dangerous for the currents of the highest intensity are generally conveyed over the smallest wires. Furthermore, the best of insulation, even though it is whole and new, is not an infallible protector against currents of the highest intensity. Hence it will not do to conclude that insulation alone is necessary. For reasonable safety, substantial and proper construction is necessary in addition to good insulation, if, in fact, it is not superior in importance to insulation."

The inspector found that most of the old wires had "underwriter's" insulation. Half the wires in Louisville have that inferior insulation.

In regard to the construction, he says that the poles should be strong and not too far apart. "I find," he says, "wires carrying intense currents over housetops, within a few feet of tin roofs or insecure fixtures, some in such position that persons passing over can barely escape contact with the wires, and others so placed as to be within the easy reach of persons standing on the roof.

"In conclusion," he says, "I have to call attention to the custom that prevails of running arc light circuits along iron awning frames, the lights being suspended from the frames, no other precaution being taken to prevent the charging of the frames than to run okonite wire or porcelain knobs attached to the frames. While this is regarded good insulation per se, it is questionable whether the attachment of the arc light circuits to iron awning frames should be permitted at all. It may be contended that no harm can result other than, perhaps, that in the event of contact between a frame and a wire, a passer-by, standing on a brick pavement, may, in touching an awning post, set in a block of granite, receive a shock more or less severe, but not sufficient to do severe harm, but even such a shock is a sensation that no one cares to experience involuntarily and without notice." B. A.

Boston, Mass.

BOSTON, March 1.—The annual order in regard to the establishment of a municipal lighting plant was up for a final hearing before the Board of Aldermen in this city this week. It was quickly disposed of by "indefinite postponement," which means that Boston wants no city plant.

The question of an isolated incandescent plant for the city hall and other municipal buildings is being agitated by the city council of Boston, and similar measures are to be taken in Chelsea, Mass., where $3,000 is to be spent provided a satisfactory contract can be made for a plant at that price.

The committee on taxation of the state legislature recently gave a hearing on the order concerning the taxation of foreign corporations, especially as to changes in the law relating to taxation of telephone companies. Hon. G. A. Bruce opposed the order in behalf of the Bell Telephone company.

On Tuesday evening of this week the Board of Aldermen in Cambridge passed an order prohibiting the running of tow cars by the West End Street Railway company. All cars must be run singly instead of in trains, as heretofore. This unexpected order, which went into effect upon its passage, has caused considerable confusion and inconvenience to the public, as the railway company did not have a sufficient number of motor cars equipped to replace the tow cars. The summary action of the aldermen is very widely criticised and condemned.

The Bell Telephone company makes the following statement of output of its instruments: December 20 to February 20, gross output, 1889-90, 7,640; 1888-89, 8,087. December 20 to February 20, net output, 1889-90; 3,138; 1888-89, 3,949.

The Thomson-Houston Electric company has sold over $1,500,000 preferred stock under the offer to shareholders at 25¼, the company having an option to buy it back in a year at 28. There still remains unpaid on the Brush purchase $1,300,000, maturing in monthly installments, the last in January, 1891.

The subject of "Electricity" has become a favorite one with the various clubs in Boston. On Wednesday evening of this week G. E. Cabot of the Holtzer-Cabot Electric company, led a discussion on electric fittings at the rooms of the Boston Architectural club. "Electric Lighting" was the subject of the discussion at the dinner of the Chickatawbut club, at Young's, on Thursday.

BOSTON, February 27.—A very sad accident occurred on Monday last resulting in the death of George H. Bradford, a young business man of Boston. The horse which he was riding along Beacon street became frightened and jumped in front of an electric car, and the rider and the horse were instantly killed. In the investigation by the railroad commissioners no blame is attached to the driver of the car or to the electric system. The commissioners, however, strongly urge the adoption of suitable fenders for both the front and sides of the wheels upon all electric cars when run at high speeds.

The twentieth annual meeting of the New England association of Gas Engineers was held in Boston this week. A paper was read by Samuel J. Fowler, of the Westfield Gas Light company on the "Management of a Small Gas and Electric Light Plant." Charles F. Pritchard, general superintendent of the Lynn Gas & Electric company, Lynn, Mass., was chosen president of the association.

The Boston Society of Civil Engineers was favored at their monthly dinner this week by a paper from Capt. Eugene Griffin, of the railway department of the Thomson-Houston company, upon the subject of "Electric Railways." In the afternoon they inspected the construction work of the West End Street Railway company at its new power station where hundreds of piles are being driven into "made" land for the foundations of the machinery to be used in generating electricity for the railway system.

The committee on mercantile affairs of the legislature has reported a bill authorizing the Edison Electric Illuminating company, of this city, to increase its capital stock to $2,000,000.

At the dinner of the Boston Electric Club last Monday night Arthur Lord, a prominent attorney of this city, read a paper on "Legislation Relating to the Transmission of Light, Power and Intelligence by Electricity." The discussion will take place next Monday night. O. H. M.

THE ELECTRIC LIGHT.

The Woodberry & Belt Electric Light & Power company, Baltimore, will erect an electric light plant this spring.

The Shreveport, La., Railway & Improvement company will install a Thomson-Houston electric light plant immediately.

A contract for a 600 light 16-candle power plant at Marlin, Tex., has just been closed, and the installation will be made immediately.

The Westinghouse Electric company has been awarded the contract for a 3,000 light plant of the alternating current system in Lexington, Ky.

The Binghamton Gas & Electric company of Binghamton, N. Y., has increased its electric lighting plant by the addition of Westinghouse alternating current apparatus of 750 lights' capacity. The Binghamton station will now have a total capacity of 3,000 lights.

The alternating current central station at Savannah, Ga., has for some time been overrun with business, which has necessitated additional facilities. A contract was made a few days ago with the Westinghouse Electric company for a 750 light machine. This gives the plant a total capacity of 3,350 incandescent lights.

The Suburban Light & Power company of Boston, Mass., is rapidly progressing with the installation of its machinery. The arc light apparatus, Westinghouse converter system, has nearly all been shipped, and the company contracted a few days ago for a 750 light dynamo of the Westinghouse alternating current incandescent system.

A florist in London, England, has had the happy thought of hanging trails of moss over and around the electric lights in his window. Nothing could be more gracefully pretty than their soft environment. The green and yellow tints of the delicate leaves form a lovely veil for the light, which glimmers through them without being diminished.

Among the latest contracts of the Westinghouse Electric company are a 60 light arc machine for Denison, Tex., and another from Saratoga, N. Y., for the same kind of a dynamo. The plant in Saratoga Springs is a new one, and it will be furnished exclusively with Westinghouse apparatus, the incandescent light capacity amounting to 1,500 lamps.

The Business Men's Club of Evanston, Ill., at their ball recently illustrated the death of the old mode of illumination and the birth of the new. As the guests fell in line for the opening march, the orchestra commenced playing the "Dead March in Saul," and as the solemn dirge was wailed forth, the supply of gas with which the hall has hitherto been lighted was shut off, and darkness reigned. Suddenly the jubilant strains of "See, the Conquering Hero Comes," rang out from the orchestra gallery, and in an instant the room was flooded with the soft radiating light of 300 incandescent lamps, suspended from the ceiling, or grouped in clusters around the hall.

THE ELECTRIC MOTOR.

The East St Louis Electric Street Railroad company has been incorporated to operate a railroad; capital stock, $150,000; incorporators, D. Sullivan, H. F. Bader, and H. D. Sexton.

O. M. Hubbard, Cincinnati agent for the Jenney Electric Motor company of Indianapolis, recently installed a motor for pumping the mammoth organ at the Odeon and Cincinnati College of Music.

One of the most important actions ever taken by the city council of Pittsburgh was the granting of ten franchises for street railroads last week. The proposed lines will traverse the principal streets of the city and afford rapid transit. It is proposed to equip eighty miles of road with electric and cable systems, and it is estimated that the cost will exceed $3,000,000.

City councils and daily newspapers would do well to emulate the example of their brethren in Rochester, N. Y. Here is an extract from the *Sunday Herald* of that city in which the true spirit of enterprise and local pride is shown: "There should be a general co-operation among citizens to aid the company in getting the requisite consents and concessions so that the long-needed rapid transit shall not be further delayed. The feeling of citizens toward this company should be guided by motives of public policy and no one should show a disposition to harass the promised improvement by frivolous objections, such as are sometimes made more in the spirit of personal cussedness than be-

cause there is a valid excuse for such obstructive tactics. Let us all join hands and earoestly aid this progressive movement for the betterment of Rochester and its residents."

A new electric snow-plow, manufactured by the Sprague Electric Railway & Motor company is operated on the Troy & Lansingburgh Street Railway company's lines. This plow is fitted with two 25 horse power improved Sprague motors, and is so arranged that it can be run either forward or backward, similar to an ordinary Sprague electric car. The reduction in gearing between the motors and the car axles is greater than in the ordinary Sprague car, so that a large amount of power is available from the motors in case of necessity. It is estimated that this plow will clear the track more speedily and effectually than an ordinary snow plow drawn by twelve horses.

THE TELEPHONE.

Superintendent Miles, of the District Telegraph & Telephone service finds that it will cost $30,700 more than the $250,000 of the original estimate, to place the telephone and fire alarm wires underground in Washington, D. C., and he has recommended the additional appropriation of this sum.

The Memphis, Tenn., exchange of the Cumberland Telephone & Telegraph company, is reported to be the best equipped in the state and one of the finest in the country. The plant is worth half a million dollars.

THE TELEGRAPH.

'Frisco sharpers have of late been playing tricks on the pool sellers of that city, and by resorting to the old method of tapping the special wire and holding back reports, it is said the book makers were fleeced of $50,000. A telegraph lineman made the discovery that the line had been tampered with.

In addition to the list of subscribers for the National Fast Telegraphing Tournament, which have been published, the Western Union Telegraph company and its general manager have contributed liberally, as will be seen from the following extract of a letter from General Thomas T. Eckert, vice-president and general manager of the company to Fred Catlin, manager of the tournament: "It gives me pleasure to send you herewith a check for one hundred dollars, as the company's contribution to the prizes to be competed for, and to add thereto my own check for $25. I need not say to you, and through you to the operators generally, that I take a great interest in the tournament, which will show flattering evidences of their skill, and of the possible achievements of the best equipped men on the lines." It has been suggested that a prize be offered to operators who were in the service prior to 1865, as it would give some of the old timers a chance to show how well they have maintained their grip.

Miscellaneous Notes.

The Boston Electric club announces a membership of 200. This organization was formed in 1887. It has just taken possession of new rooms at 7 Park St. An excellent literary programme has been prepared for the season.

An ordinance is now in force in San Francisco, Cal., against the stringing of electric wires over buildings, and the chief of the fire department is authorized to enforce its provisions, and cut all wires that are permitted to remain ten days after notification has been given to remove the same. Under its provisions no person or corporation can suspend electric wires upon the roofs of buildings, unless the wires are in use to supply the occupant of the building with electric light or power, or telegraph or telephone service. Under all circumstances permission must first be obtained from the supervisors. Wires used exclusively for fire alarm and city and county purposes are excepted.

Personal Mention.

E. T. Bubier of Lynn, Mass., was in Chicago last week.

Frank Rae of the Detroit Electrical works, visited Chicago last week, and was entertained at the Electric club.

Daniel C. Hemingray, of the Hemingray Glass company of Covington, Ky., and Muncie, Ind., was entertained at the Chicago Electric club this week.

Business Mention.

Partrick & Carter, Philadelphia, in a recently published pamphlet call attention to their new covered cell, disque battery, and many other excellent electrical devices which they have just placed on the market.

The Knapp Electrical works of Chicago has the Western agency for the Burnley dry battery for telephone and telegraph work, electric bells and electro-medical use. This battery is giving general satisfaction.

C. R. Vincent & Co., of 15 Cortland St., New York, Eastern agents for the Ball Engine company, secured the contract for 12 of the engines in the new Brooklyn Edison station, of which a description was given by C. J. Field at the recent electric light convention.

The Inman & International Navigation company has recently purchased of Jarvis B. Edson, 87 Liberty street, New York, two pressure recording gauges for the chief engineers' rooms in the City of Paris and City of New York. The Hamburg-American Packet company has also ordered two of these gauges for the new steamers Russia and Normannia.

Fairbanks, Morse & Co. have recently perfected arrangements to handle the well-known Rice automatic engine in the West. They also make a specialty of Smith-Vaile steam pumps for fire purposes, having special designs and improvements to achieve best results in this line. The high standing of this firm is a guarantee that all goods handled by them are exclusively of first quality. Their houses are located at Chicago, St. Louis, Kansas City, Denver, Omaha and St. Paul, where they will be glad to see all interested in these lines.

The Jas. H. Mason primary battery is receiving most complimentary testimonials to the effect that the battery does more than is promised. Its use in lighting with miniature incandescent electric lamps designs of flowers, trees and other arrangements for artistic settings in entertainments, is increasing. For an entertainment in Brooklyn last week W. T. Knox designed an electric tree lighted with many tiny incandescent lights and over the tree a large star at each point of which were small lights. At the foot of the tree were two owls whose eyes shone with the electric light. All these lamps were run with the J. H. Mason primary battery.

W. M. Donaldson, an electrical engineer of Baltimore, has recently entered into the business of distributing electrical energy by means of storage batteries in connection with small motors for household and office use in the cities of Baltimore and Washington. In Baltimore his batteries are charged by the arc light wires, and in Washington by a Perret dynamo. Mr. Donaldson's business seems to prosper, judging by his recent order on the Elektron Manufacturing company for forty Perret motors to operate graphophones, which he has adopted for this work. In some recent tests with this motor on graphophone work, using a 2-volt battery, when recording the motor took 2.3 amperes, and when reproducing, 2 amperes. With the ordinary 100 ampere-hour storage cell, the motor will drive the graphophone from forty-five to fifty hours continuously, which lasts an ordinary business man about one month, the battery being then replaced by a freshly charged one, and the discharged battery taken to the charging station.

The Sioux City Engine Works are just starting up work in their new buildings at Leeds, Sioux City's new manufacturing suburb. The foundry, which has been in operation for some little time, has fully four times the capacity of the old foundry. The increased facilities will enable the company to make a specialty of foundry jobbing and heavy contract work, such as architectural iron work in cast iron, as well as wrought iron street and cable-car railway castings, standard railway castings, and contract work for manufactories. The Sioux City Engine Works have on hand a large number of orders for engines, mostly in larger sizes, which they will push forward just as soon as possible in their new works. They have fitted up their machine shop with rope transmission throughout, also with one of the Buffalo Blower company's large heaters and blowers for warming the buildings, and will put in one of the Hawkeye Electric company's dynamos for lighting the works. They have already placed orders for new tools, and are selling off quite a number of their old tools, to be replaced by heavier and stiffer machines of later designs, the object being to thoroughly equip these works with the most improved machinery, and thereby put them in condition to compete with any works of the kind in the country. They have recently issued a new boiler circular, showing the types and sizes of boilers they build. They will make a specialty of high grade boilers. They have also in preparation new circulars of both types of their engines, viz., the Sioux City Corliss, and the Giddings automatic engines, and also of their boilers.

Electrical Patents.

Issued Feb. 25, 1890.

421,887. Electrically-Propelled Vehicle. James Adair, New York, N. Y.
The design or object of the invention is, primarily, to produce what for convenience is designated an "electrical rink"—that is to say, to provide an economical and practical plan for the automatic propulsion in any desired direction of bicycles or any other similar vehicles over a given area.
The claim reads:
"The combination, with a conducting surface forming a bed over which one or more vehicles may be run in any desired direction, and a conducting surface above the same parallel to and coextensive with the bed of one or more electro-magnetically propelled vehicles; devices for connecting the terminals of the motors on said vehicles with the two conducting surfaces, and a generator of electricity having its poles connected to the two surfaces."

421,911. Regulating Apparatus for Electric Motors. Philip Diehl, Elizabeth, N. J.

421,916. Secondary-Battery Plate. Justus B. Entz and William A. Phillips, Schenectady,
The first claim follows:
"As an article of manufacture, the wire core covered with a braid or net-work of finer wire, and adapted for use in a battery element."

421,967. Dynamo-Electric Machine. Mathias Pfatischer, Philadelphia, Pa.
Claim 1 reads as follows:
"In a dynamo-electric machine or motor, the rotary armature and a commutator therefor, combined with one or more bars or brushes composed of carbon, and one or more bars or brushes composed of metal."

421,968. Electric Conductor. Eugene F. Phillips, Providence, R. I.
The first claim is given:
"An electric conducting wire having an inner and outer coating of insulation, and an interposed woven or braided layer composed of mingled twines or cords and metal wire."

421,983. Automatic Railway Alarm and Signal. Milton M. Souders, Litiz, Pa.

422,058. Electric Connector. Charles McIntire, Newark, N. J.

422,072. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

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422,082. Telephone-Line Vibrator. Hermon W. Ladd, Boston, Mass.
The invention consists in a telephone line having, distinct from the instruments, suitable spring vibrators, and it is embodied in its best form in a re-enforcing chamber connected to the line wire outside of the transmitting instrument, and provided with one or more inclosed vibrators, which co-operate with and give continuity to the vibratory currents traversing the line-wire.
Claim 1 reads as follows:
"The combination, with a properly supported telephone line-wire, of suitable spring-vibrators connected thereto distinct from the instrument."

422,096. Device for Suspending Electric Conductors at Crossings. Sidney H. Short, Cleveland, Ohio.

422,107. Voltaic Shoe. Clark H. Ayer, Boston, Mass.

422,147. Electric Switch. William E. Parker and Harry E. Temple, Buffalo, N. Y.

422,148. Dynamo-Electric Machine or Electric Motor. Edward B. Parkhurst, Woburn, Mass.

422,149. Electric Motor. Edward B. Parkhurst, Woburn, Mass.

422,164. Support for Overhead Electric Conductors. Charles K. Stearns, Newton, and George K. Wheeler, Boston, Mass.

422,174. Grinding Electrodes for Microphones. Samuel H. Bartlett and Henry E. Waite, New York, N. Y.

422,190. Method of Electrically Heating Bars, etc., for Welding and Working Purposes. Mark W. Dewey, Syracuse, N. Y.
The last claim reads:
"12. The method of electric welding or metal working, consisting in generating an irregular electric current in a conductor, including a coil of insulated wire, locating an iron core within the coil, placing the work in proximity to one or both of the poles of the core, suitably holding or supporting the work, exposing said work to the magnetic action until sufficiently heated, and then performing the desired operation upon the same."

422,196. Electric Lighting Device. Ellsworth E. Flora and Philo R. Hoy, Chicago, Ill.
The invention relates to that class of lighting devices wherein a spark is produced by the breaking of an electric circuit, and the object of the invention is to produce a lighter suitable for use as a cigar or gas lighter.

422,201. Electrical Apparatus for Driving Artesian Wells George G. Fryer, Philadelphia, Pa.

422,216. Secondary Battery. William B. Hollingshead, Bronxville, N. Y.

422,219. Exhaust Apparatus for Incandescent Lamp Globes. Herman J. Jaeger, Brooklyn, N. Y.

422,244. Switch-Box. Mark R. Muckle, Jr., and Thomas C. Smith, Philadelphia, Pa.

422,265. Carbon Commutator-Brush and Holder. Chas. J. Van Depoele, Lynn, Mass.
Of the ten claims the sixth is given:
"The combination of one or more carbon contacts, a commutator, a holder for sustaining the said carbons in endwise contact therewith, and through which the carbons are movable, and springs for preventing vibration of the carbons."

422,266. Electric-Railway Motor-Car. Charles J. Van Depoele, Lynn, Mass.
The most important features of the invention relate to the application of electrically developed motive power to the propulsion of the vehicle, incident to which is the disposition of the parts to secure the greatest mechanical advantages, and also the utmost facility and convenience in the matter of regulating and controlling the movements and speed of the car.

422,295. Pyromagnetic Generator and Motor. William B. Cooper, Philadelphia, Pa.
The eighteenth claim follows:
"In a pyromagnetic generator or motor, composite laminæ, which consist of magnetic laminæ, having interposed non-magnetic laminæ."

422,300. Electrode for Storage Batteries. Charles J. Hartmann, Summit, N. J.

422,301. Electrode for Secondary Batteries. Charles J. Hartmann, Summit, N. J.
Claim 1 reads:
"The carbon pencil for electric lights, made from a compressed mixture of from 80 per cent. to 50 per cent. of powdered gas-coke; from 20 per cent. to 50 per cent. of powdered coal; from 1 per cent to 10 per cent. of refractory material, and from 1 per cent. to 20 per cent. of coloring matter."

422,302. Carbon for Electric Lamps. Henry H. Head, Dublin, and Llewellyn Saunderson, Kingstown, County of Dublin, Ireland.

422,308. Electrode for Secondary Batteries. Farnham M. Lyte, London, County of Middlesex, England.

422,339 Electric-Motor Car. Isaiah H. Farnham, Malden, Mass.

422,354. Safety Cut-Out. Frank B. Rae, Detroit, Mich.

422,360. Incandescent Lamp Socket. William F. Wollin and Elmer H. Werline, York, Pa.

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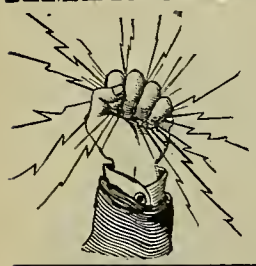

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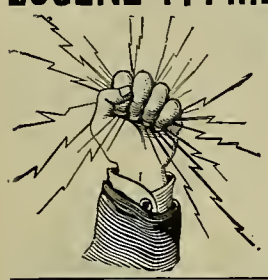

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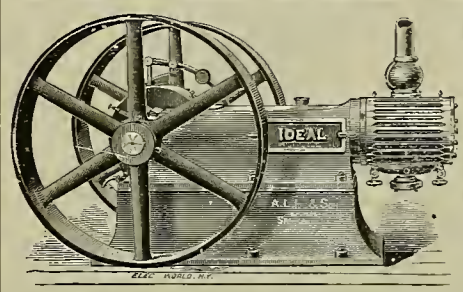

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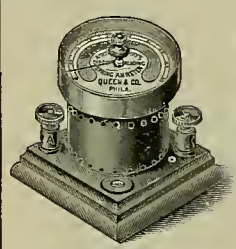

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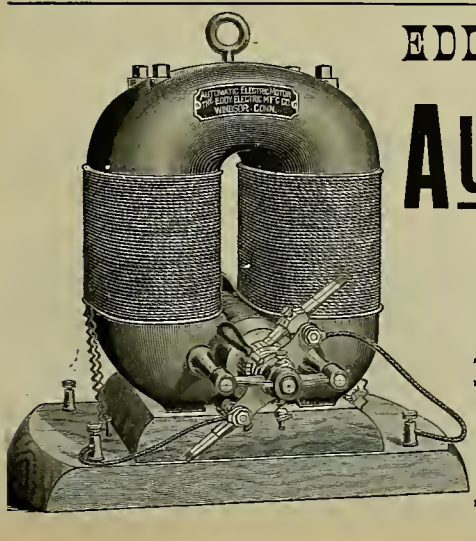

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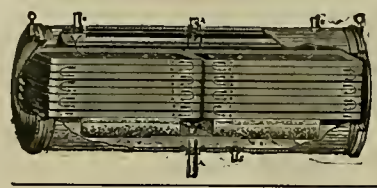

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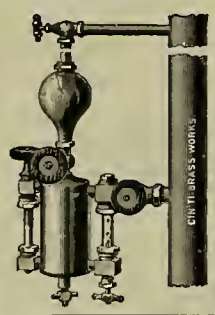

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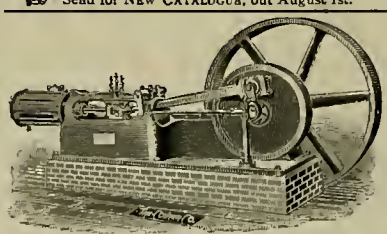

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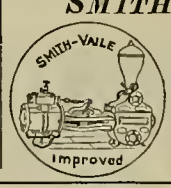

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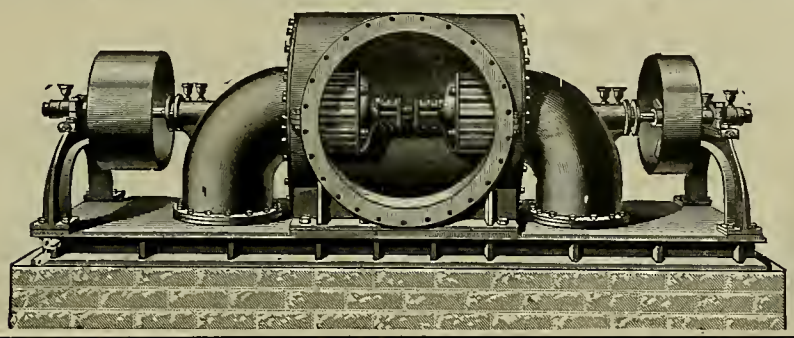

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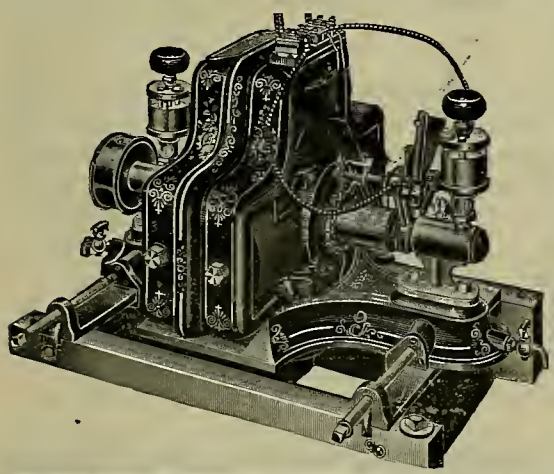

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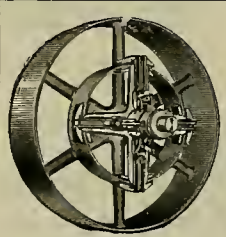

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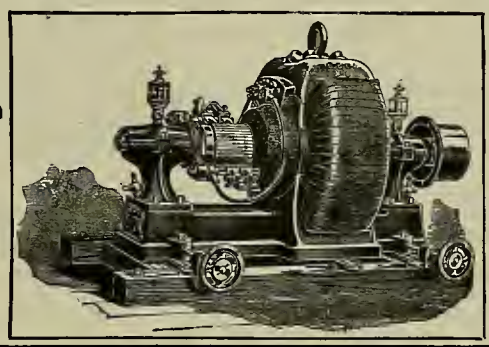

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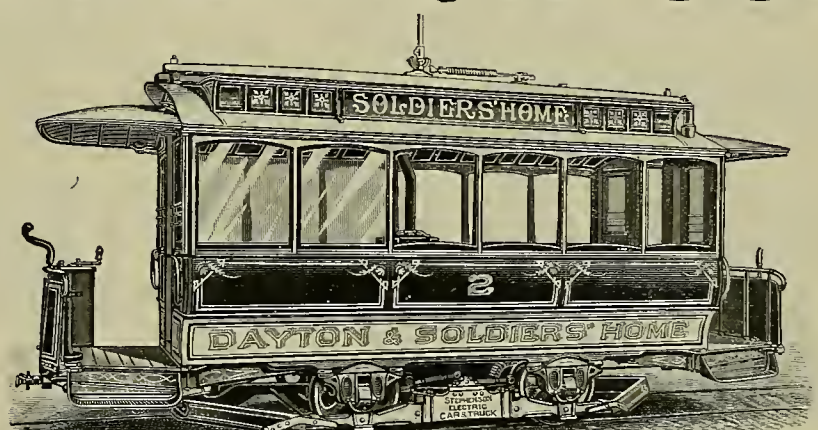

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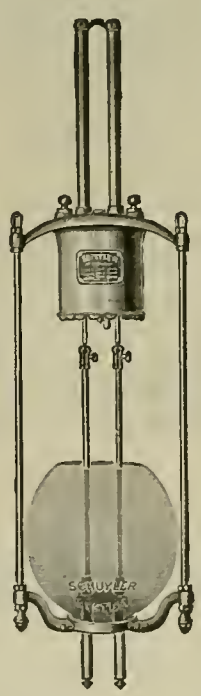

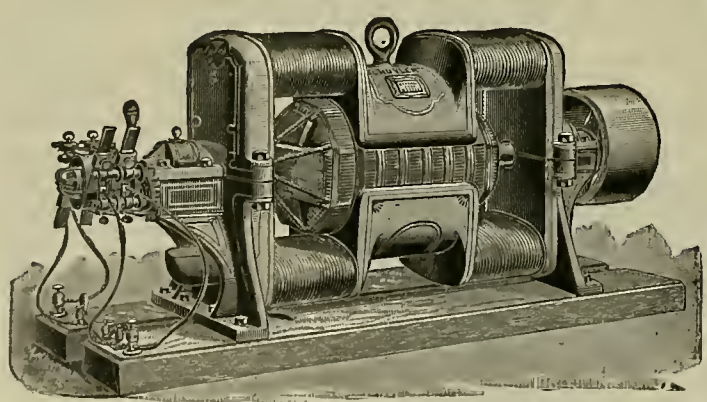

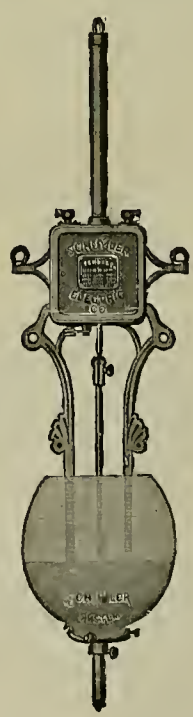

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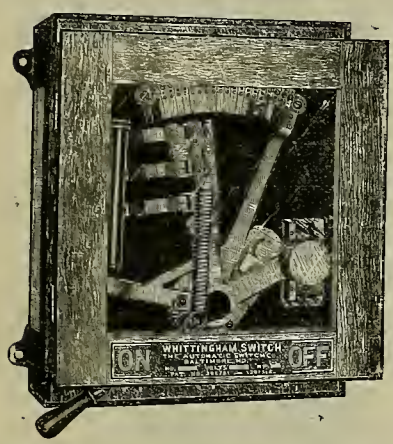

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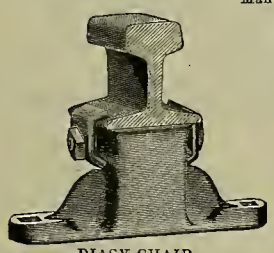

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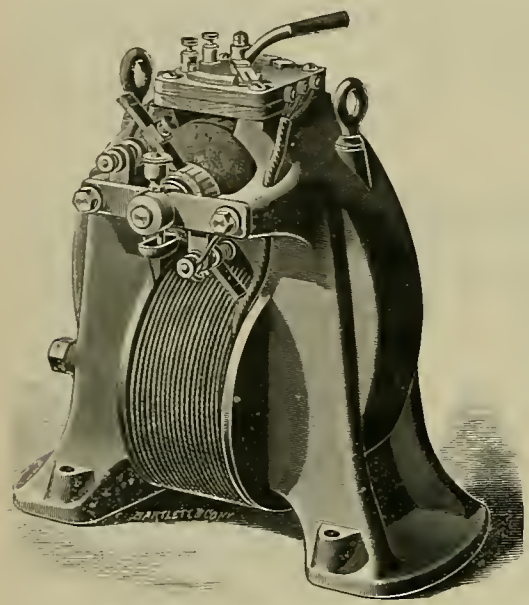

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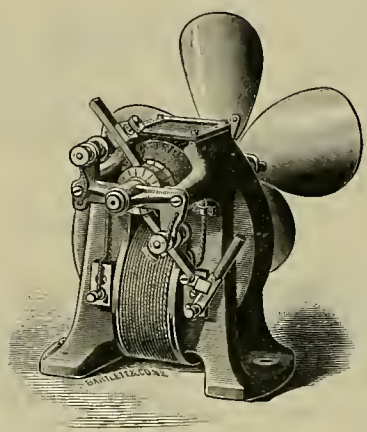

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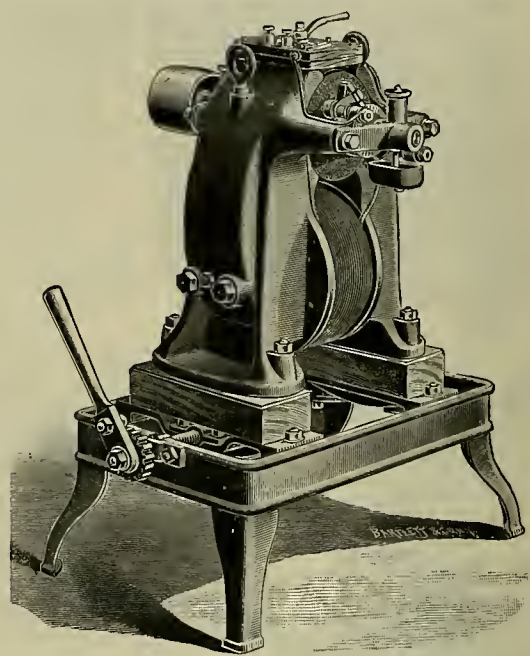

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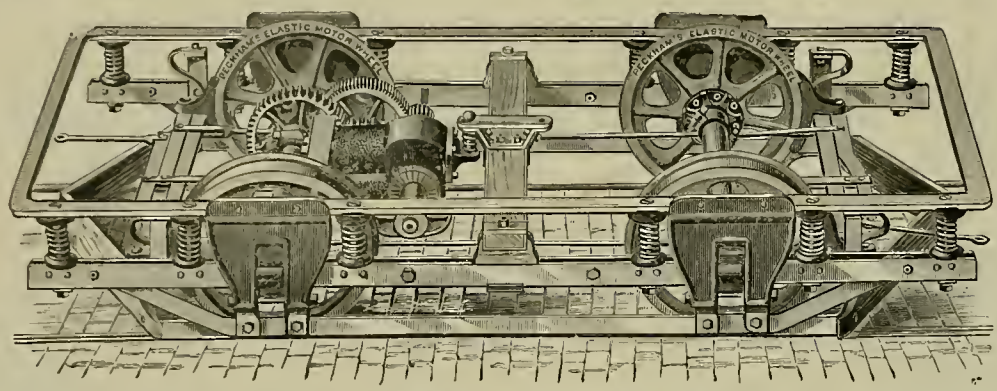

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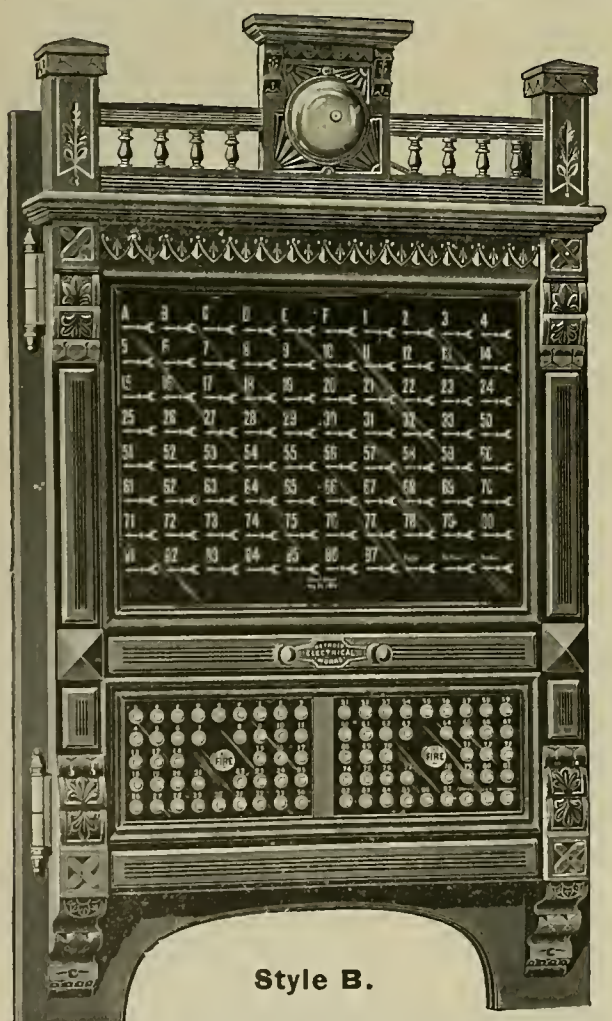

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219,208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219,208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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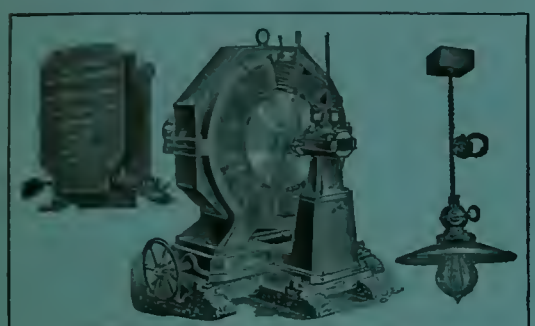

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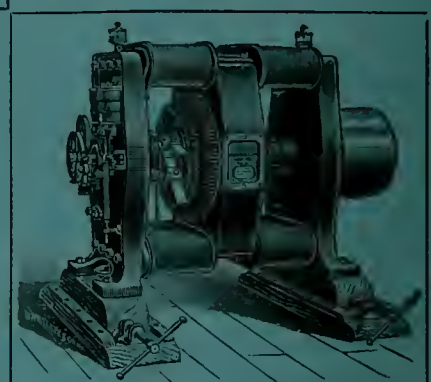

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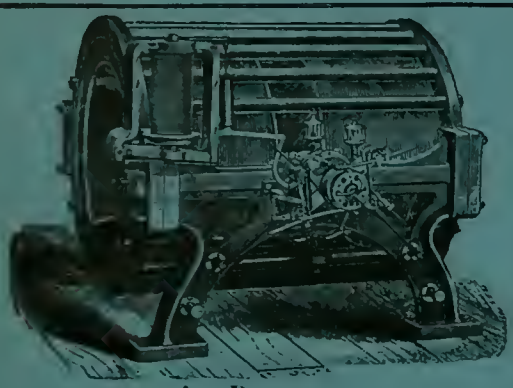

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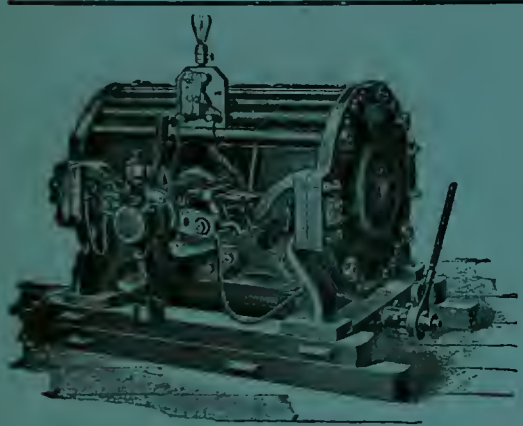

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The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

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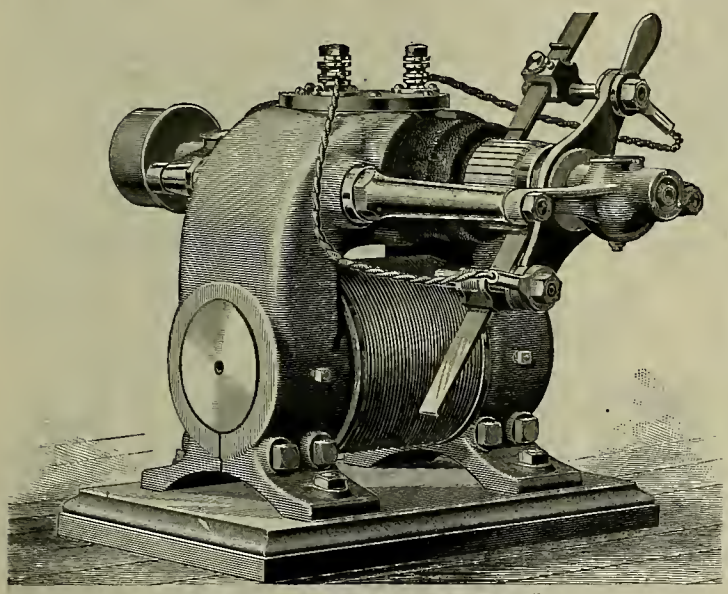

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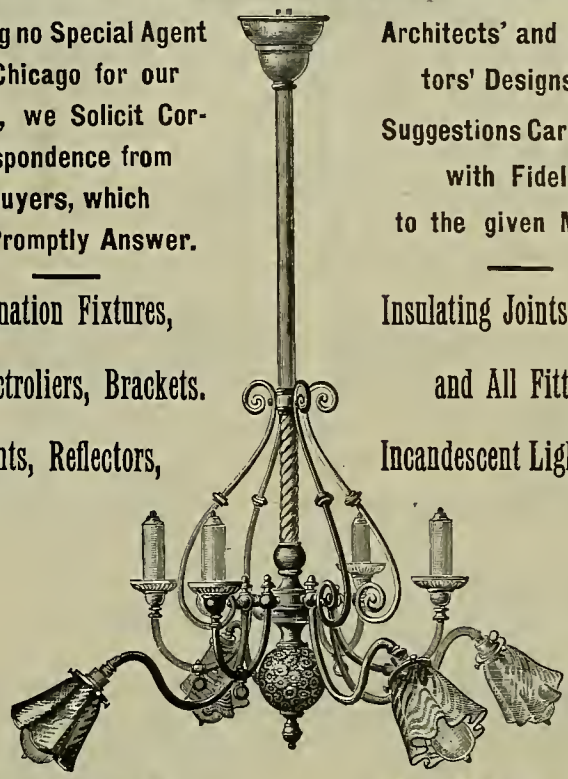

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Time	5 min.	1 hour.	24 hours.	10 days.	24 days.
Temperature	60° F.	60° F.	60° F.	60° F.	60° F.
Resistance	3.200	3,300	3,300	3,300	3,300

Time	30 min.	30 min.	30 min.	30 min.
Temperature	40° F.	115° F.	167° F.	200° F.
Resistance	3.900	162	12	5.2

The times given in the upper table are those between the immersion of the wire in water and the making of the test.

The times of the second table indicate the time between that at which the tank reached the indicated temperature and that at which the test was made.

The cable had been immersed in water for a month before the first temperature test was made.

It will be observed that the temperature being at 60° F. the resistance remained constant at its highest point for 24 days, and than raised greatly on lowering the temperature.

The lowering of resistance by a rise in the temperature is a common characteristic of all such insulations and indicates no defect. Most insulations are much more affected by this cause than was this one.

This wire also showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas. Very truly yours,

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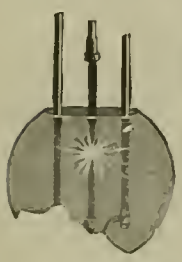

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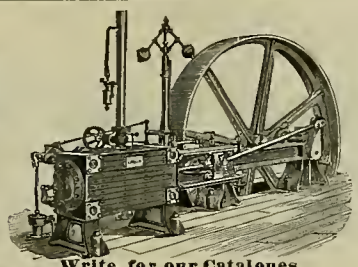

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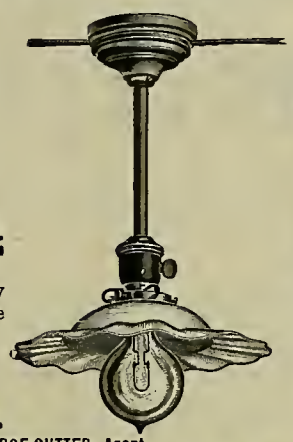

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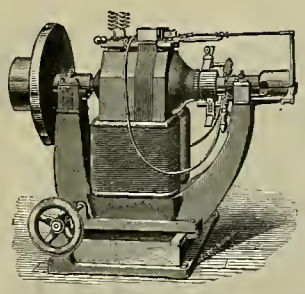

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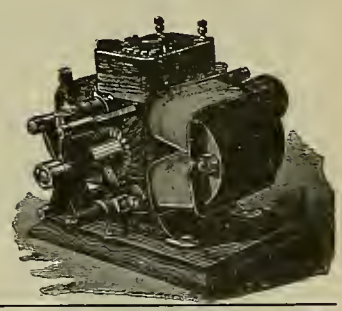

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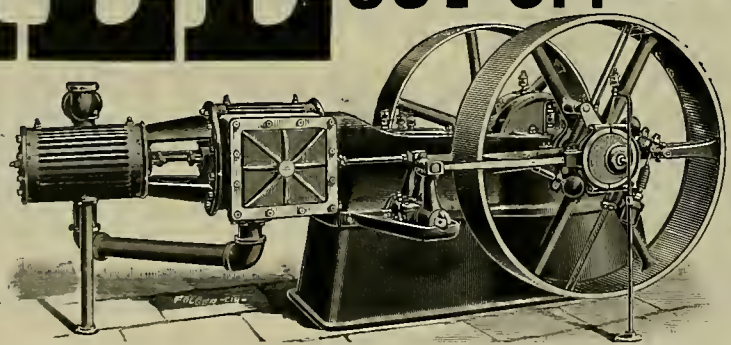

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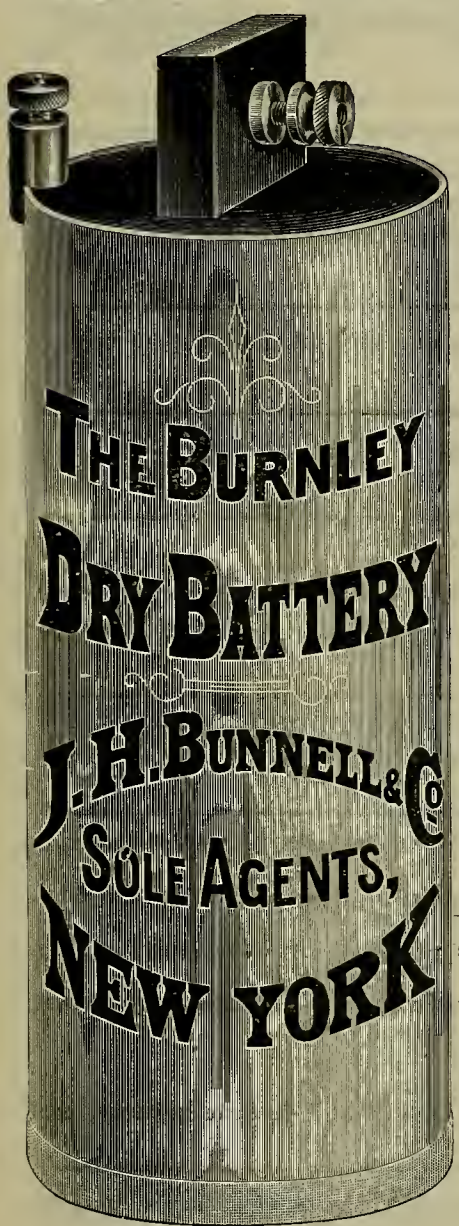

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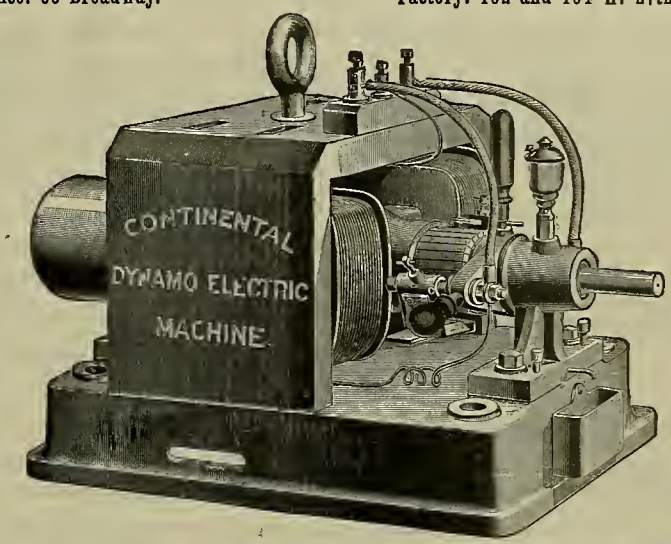

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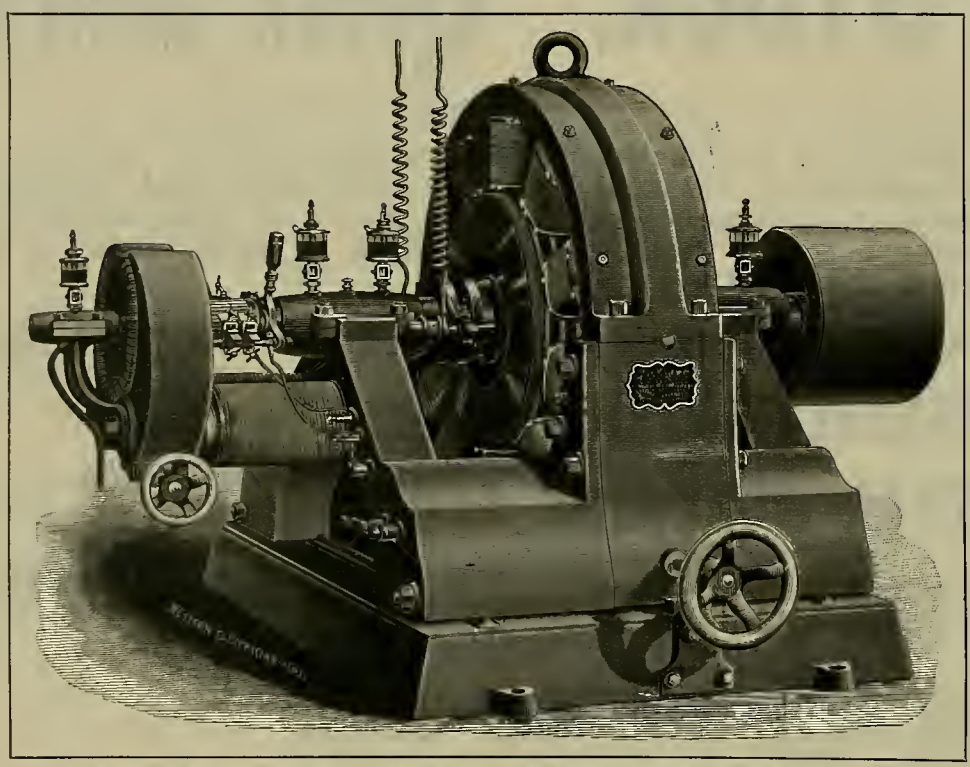

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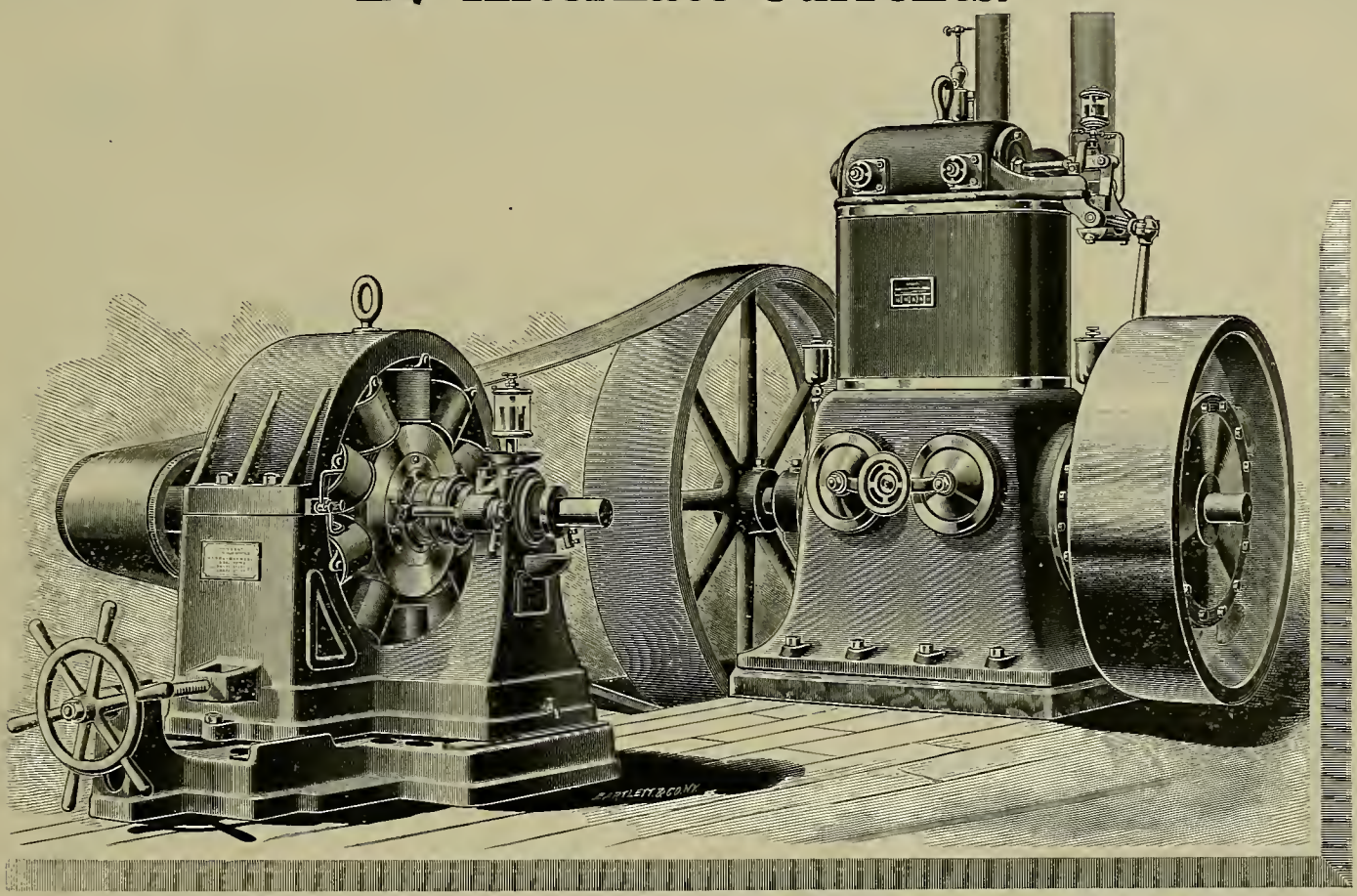

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Minneapolis, St. Paul, St. Louis.

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All the lines in Minneapolis and St. Paul and between those two cities, comprising 200 miles of track, are to be equipped with the Sprague Electric System.

(Statement of Mr. Thos. Lowry, Prest. of the Minneapolis Street Railway.)

"NEW YORK, Feb. 19, 1890.—I have to-day closed contract with Sprague Electric Railway & Motor Co. for the Electrical Equipment of the Street Railways in Minneapolis and St. Paul, and between those two cities."

(Signed) *THOS. LOWRY, Prest.*

St. Louis follows with an order for sixty-eight car equipments for the Lindell St. Railway in that city.

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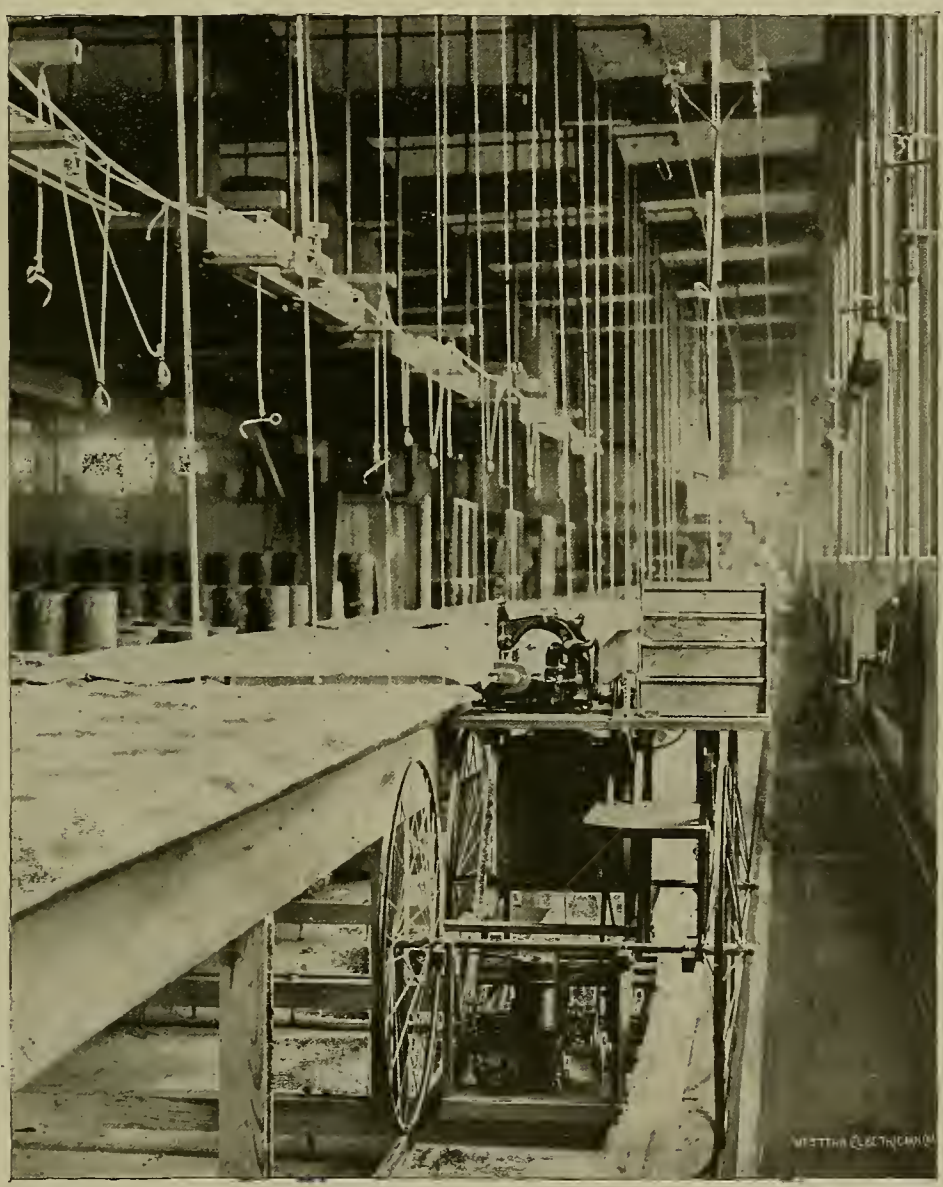
Vol. VI. CHICAGO, MARCH 15, 1890. No. 11

Electric Carpet-Sewing Machine.

The cut presented herewith illustrates a novel machine which is in operation at Marshall Field & Co.'s, Chicago. The apparatus might be described as a traveling carpet-sewing machine. It is driven by electricity, and is arranged to feed itself automatically along the edge of a carpet, the lengths of which it sews together as it travels along. The carpet is laid upon a long table, shown to the left in the illustration.

Previous to the introduction of this machine, which is the invention of Franklin Ames, manager of the carpeting department of Marshall Field & Co.'s wholesale house, it was found to be impossible to sew ingrain carpets except by hand. An operative ordinarily was able to sew about 25 yards per day. By the use of this apparatus, it is claimed, a speed of 2,500 stitches per minute, which are sufficient to sew 8 yards of carpet, is attained with ease. In addition to this, the seam produced is perfectly flat and elastic.



ELECTRIC CARPET-SEWING MACHINE.

Referring to the cut, it will be seen that the apparatus consists essentially of a table, about 100 feet long, a track and a traveling carriage, which supports the sewing machine, proper. The table and track extend the length of the room. The carriage is fitted with four bicycle wheels, and is light but strong. Upon this are arranged, as shown, a sewing machine and a ¼ horse power C & C, 110 volt, incandescent motor, with its resistance box. The motor is set under the forward axle of the carriage, while the rheostat is supported at the rear end under a shelf which carries the sewing machine. The motor and machine are belted together, as indicated, and the latter is set so that its needle plate is at exactly the same height as the top of the table. Suspended tightly above the carriage are two ⅛-inch brass wires. These extend over the entire length of the track, and are connected with the wires from the Edison plant, which lights a portion of the building. Current is supplied to the motor from these wires through trolleys carried by the slender T-shaped arm which extends upward. Connecting with the rheostat arm is a pedal which is hung beneath the seat so that it may be operated by the foot of a boy, seated upon the carriage. There is also an upright standard connecting with the treadle, which may be operated by a lever to set the machine at any required speed. This last-named attachment makes it unnecessary for any operative to ride upon the carriage. A self-feeder is also connected with the front of the machine. This attachment renders it unnecessary for the operative to touch the work with his hands. It may be further mentioned, too, that there are fitted into a groove running the entire length of the table, a number of blocks and clamps by means of which any number of short carpets can be connected together and all stretched at once, and the machine run through, sewing them all without stopping. The handling of long and heavy carpets is greatly facilitated by the rigging hung just above the table. This consists of a rope extending over pulleys the entire length of the table, and having attached to it at intervals small cords with a hook at the end of each. When it is desired to turn the breadths, the hooks are fastened into the edge of the carpet and a small windlass, which is connected with the main rope, is wound up. By this operation the carpet is raised on edge, and held there until another breadth is put in place. As the hooks are designed so as to release themselves from the carpet when they are brought up into contact with the framework above, an extra turn or two of the windlass is all that is required to release the carpet. The practical working of the machine is as follows: The carpet is stretched upon the table by means of the two blocks sliding in the groove in the table, one being made stationary at any desired point, the other containing a windlass with ratchet to stretch the carpet at any desired tension, and hold it until sewed. The figures in the carpet are matched, and basting pins put in about three feet apart. These basting pins are connected with small cords, shown to the left in the illustration, extending up and through two small pulleys which hang from wires strung overhead along the entire length of the table. To the opposite ends of each of the cords is attached a small weight. A V-shaped guard is placed back of the needle on the machine. This, as the machine travels along, comes in contact with the cords a few inches above the carpet or pins, and as a small wooden disk or stop is made fast on the cord just above the point where the guard strikes it, all the pins are pulled out as fast as the carpet is sewed. The pins are drawn up by the small weights at the other end to a convenient height, and are prevented from going through the pulleys above by another wooden stop placed at the proper point on the cord. From the above it will be seen that a small boy can start the machine and then go ahead of it, matching the carpet and pinning it, and the machine will follow him, sewing the carpet and taking out the pins, as has already been stated, at the rate of 8 yards per minute. When a different stitch is required, as for instance, when the apparatus is to work on Brussels carpet, another sewing machine may be attached to the carriage with but little trouble. The inventor also proposes, when it is required, to place two carriages on the

track. By this addition, both Brussels and ingrain carpets may be sewed on the same table at the same time. At a busy season of the year, by the use of another pair of stretchers and adding one more operative, the entire capacity of the machine may be more than doubled. As Mr. Ames states that, with the two machines and six boys, an amount of work equivalent to that performed by 300 girls may be accomplished, the great saving effected through the use of this machine will be realized.

Operating Telephone Signal Bells by Current from a Central Station.

The cuts presented herewith illustrate a simple yet ingenious method of commuting a continuous incandescent current so that it may be utilized for telephone service. This method has recently been put to a practical test by the Chicago Telephone company with the most satisfactory results, it is claimed. By this system 61 operators, practically the whole exchange, draw the current for the operation of the bells on their respective sets of lines, from the Edison system through a commutator similar to that shown in Fig. 1. A diagram of the connections is presented in Fig 2. By this commuting device, which is driven by a small water

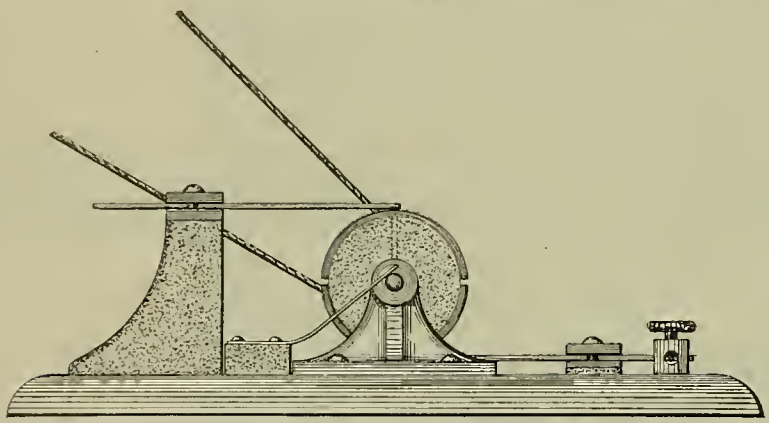


FIG. 1.—OPERATING TELEPHONE SIGNAL BELLS BY CURRENT FROM A CENTRAL STATION.

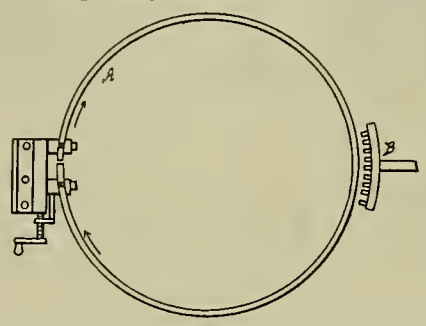
motor, the current is alternated from 400 to 700 times per minute. Referring to the diagram the construction of the apparatus will be readily understood. To the left are represented the three mains of the Edison system, with fusible plugs in circuit. The commutator *C* is connected with these as shown. The two brushes of the commuting device are connected respectively with the + and — main of the incandescent system, while the neutral wire runs to one segment of the two-part commutator, *C*. In series between the plug terminal of the neutral wire and the commutator, is the primary coil of a transformer *T*, and an incandescent lamp. One end of the secondary coil of this transformer, which is of special design, connects with the earth, while the other runs to the switch-board in the operating room. The keys at the switch-board are represented at *K*. The action of the device is as follows: The commutator *C* is kept in constant motion by the water motor, and the one segment which is connected with the primary of the transformer, comes therefore alternately into contact with the + and — brush. In this manner the direction of the flow of current in the primary is changed at every revolution. The result is that an alternating current of like character is induced in the secondary coil. As one end of this coil is grounded and the other runs to the switch-board, it is only necessary to press a key, represented at *K*, to send an alternating current over a line.

This method of operating the signal bells of a telephone system by central station current is the invention of J. J. O'Connell, electrician of the Chicago Telephone company.

Among the contracts for alternating current apparatus for central station lighting obtained by the Westinghouse Electric company during the first two weeks of February, are the following: Williamsport, Penn., 750 lights, increase; Butte, Mont., 750 lights, increase; Fort Worth, Tex., 850 lights, increase; Sioux Falls, S. D., 750 lights; Pineville, Ky., 500 lights; Lexington, Ky., 3,000 lights; Creston, Iowa, 750 lights; Snidznoka, Japan, 1,500 lights.

A Wrinkle in Electric Welding.

In the process of welding hoops by electricity when the ends of a hoop are brought into contact and the current is turned on, the resistance at the joint where the weld is to be made is usually greater than the resistance of the hoop itself, owing to imperfect contact at the joint, or



A WRINKLE IN ELECTRIC WELDING.

the ends not being in contact when the heating is done by springing a voltaic arc between the ends. The current will therefore traverse the hoop from clamp to clamp, through the body, unless some means be provided to render the resistance of the hoop greater than the resistance of the joint.

The accompanying cut illustrates a simple method of raising the resistance of a hoop by means of a gas-jet. Referring to the cut, B represents a gas-jet adapted to throw a flame against the continuous part of the hoop between the clamps. The object of this is to heat a portion of the hoop until the total resistance of the hoop becomes greater than the resistance at the joint. By thus increasing the resistance, the bulk of the current will traverse the joint, and thereby raise the ends of the hoop to a welding heat, instead of being short-circuited. When the ends are brought to a welding-heat, the weld is made by forcing the ends together by means of the movable clamp. This method is the invention of C. L. Coffin of Detroit, Mich.

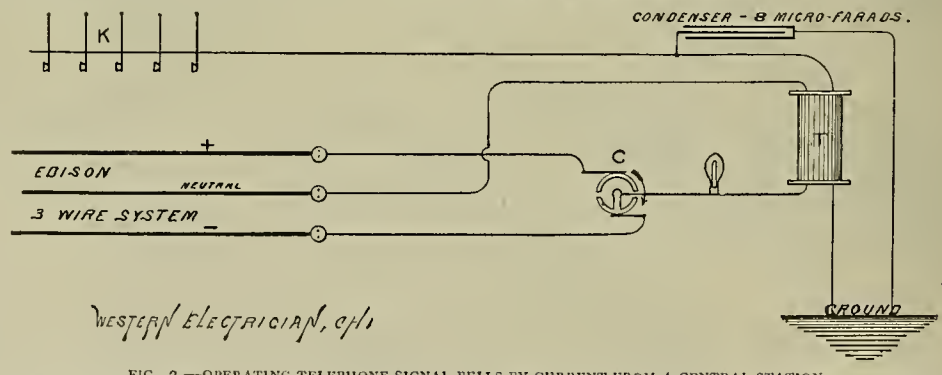


FIG. 2.—OPERATING TELEPHONE SIGNAL BELLS BY CURRENT FROM A CENTRAL STATION.

Harnessing Niagara Falls.

A. J. Coffee, city electrician of Portland, Ore., was in Chicago last week investigating the municipal fire alarm and police telegraph. The system will probably be adopted in Portland. Speaking of the scheme of harnessing Niagara Falls, Mr. Coffee said the plan was entirely feasible. "That the scheme is practicable," explained Mr. Coffee, "is illustrated by the execution of a similar project in Oregon. The Oregon City Falls are twelve miles from Portland on the Willamette river. These falls are controlled by an electric company, and from the power, transmitted by wire, all of the electric lights in the city of Portland are run. Not only is the city lighting obtained from the falls, but power for four electric street railways, elevators, small manufactories, and other mechanical industries. If this is done with our small falls twelve miles from the city, such a plan to utilize the waters of Niagara is not in the least problematical. In the twelve miles of transmission only 10 per cent. of the initial power given at the terminus of the dynamo is lost. That is practically nothing. Even if the power were transmitted sixty miles, there would be only 50 per cent. lost. The cheapness of the power would more than make up this loss."

Pan-American Conference on Patent Laws and Trademarks.

The action of the Pan-American conference at Washington, March 3, when the report of the committee on patents and trademarks was considered will be of great interest to inventors throughout this continent. The report was approved by the conference. The tenor of the document can be seen from the following extracts:

"The person who discovers new industrial products, or invents new processes for their preparation or manufacture, or improves upon the processes already known, contributes by his discovery or invention to the development of industry and to the increase of public wealth; and has a right thereto as clear and incontrovertible under the laws of all civilized nations as that which the manufacturer has to the products of his factory, or the laborer to his daily wages. Very great importance has lately attached to the emblems and devices employed by the manufacturers to distinguish the products of their factories, and by traders to distinguish the wares which they select and place upon the market, and which are commonly called manufacturers' and dealers' trademarks. The tradesman or merchant who obtains a reputation for the superiority of articles which he distinguishes by a certain trademark, acquires a right to this mark, which the law should foster and protect; and it should punish those who violate this right, either by making unlawful use of, or by counterfeiting or forging, a mark belonging to another."

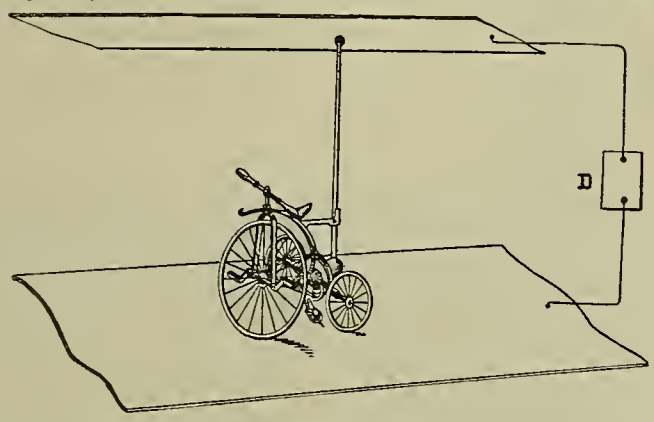
The report reviews the history of the movement in Europe for the protection of inventors, etc., and then dwells on the action of the recent Congress of Private International Law of Montevideo, assembled in response to an invitation issued by the government of the Argentine Republic and the republic of Uruguay to the other nations of South America. To this conference is due, it is claimed, the establishment of international protection of literary, artistic and industrial property. Three treaties were subscribed by representatives of the Argentine Republic, Bolivia, Brazil, Chili, Paraguay, Peru, and the Republic of Uruguay, in which the principles set forth in international law are recommended by the committee of the Pan-American congress for adoption. On this point the committee says: "In the treaties referred to, literary and artistic works, trademarks, and patents of invention are clearly and precisely defined; in the same manner are prescribed the rights of authors and artists, proprietors of trademarks, and inventors, which the contracting powers guarantee and protect, the formalities to be observed in obtaining this protection and guarantee, the limits of said rights, and the manner in which they may be exercised. All the conflicts on these subjects which may arise from diversity of legislation between the contracting states are settled by clear and precise provisions, which are formulated with all due respect to the sovereignty and laws of each state. Thus, for instance, in respect to literary and artistic copyrights, it is provided that authors and artists shall enjoy the rights accorded them by the law of the state in which the original publication or production of their work took place; but that no state is obliged to recognize such rights for a longer time than that allowed to authors who obtain the same right in that state.

"With regard to the duration of patents the same principle is established, and it is, moreover, provided that the duration of the patent may be limited in each state to the period prescribed by the laws of the state in which the patent was first granted, if such period be the shorter. It

is also provided that questions arising on the priority of invention shall be settled according to the date of the application for the respective patents in the countries where they were granted. Finally, in all these treaties the principle is established that those who violate the rights of property therein recognized and guaranteed, can only be legally arraigned before the courts of the country in which the offence may have been committed."

An Electric Rink.

The accompanying cut illustrates a novel application of electricity, which has recently been patented by J. Adair, of New York. The invention might be described as a rink in which it is proposed to propel bicycles or other vehicles



AN ELECTRIC RINK.

by electricity. The plan of the inventor is to have the floor of the rink made of a conducting material, such as sheet iron or copper, and have it connected electrically with one pole of an electric generator. The ceiling of the rink is also to be made of a conducting material and to be connected in a similar manner with the remaining pole of the dynamo. On the surface of this rink there are to be placed a number of bicycles, each provided with an electric motor. These motors will be so arranged as to be under the control of the riders, and will take current in a manner similar to those in use on electric

FIG. 2. ELECTRIC CIGAR LIGHTER.

railways employing the overhead single trolley wire system. The general arrangement of this "electrical rink" will be understood from an inspection of the cut, in which *D* indicates the electric generator.

Electric Cigar Lighter.

The cuts presented herewith represent two styles of an ingenious yet simple novelty. The device is an electric cigar lighter. It is the invention of E. E. Flora of the Franklin Electric company, Chicago.

The entire apparatus is so simple as to require but little explanation. In outward appearance the lighter, as shown in Fig. 1, differs but slightly from that well-known form, which has a place in so many cigar stores. The chief feature of the device is that the alcohol on the end of the dip is ignited by an electric spark—no gas jet, no matches or oil lamp are required. The spark-producing apparatus consists merely of three cells of open circuit battery and an ordinary spark coil. In that style of lighter represented in Fig. 1 the wires from the battery and coil terminate in close proximity at the extreme end of the torch or staff held by the figure. When the dip which is fitted at its end with a small metallic brush, is taken from the alcohol cup at the base and applied to the terminals projecting slightly from the torch, the spark produced on breaking the circuit, ignites the alcohol. In Fig. 2 one wire from the coil and battery terminates at the end of the torch, while the other wire connects with the dip through the flexible cord. The style of lighter represented in Fig. 1 differs from the one just described, in that the dips do not require a flexible cord connection. Where these lighters are in actual service, the box containing the coil and battery may, of course, be placed out of sight under a counter or elsewhere. The device is introduced by Roper & Baxter cigar manufacturers, Chicago.

The World's Fair.

The New York *Electrical World* in its issue of March 8, says: "The indications are that the World's Fair and International Exposition, regarding which the country has been so stirred up, will be held in the city of Chicago. It is time, therefore, that those connected with the great electrical industries of America should carefully and calmly consider the importance, character and scope of this gigantic undertaking. In common with most New Yorkers, we had the idea that our own city possessed many advantages that would render it the proper place for a world's fair. Now, however, that the prize has been awarded to the energetic Western competitor, we believe that all sections should co-operate heartily with the citizens of Chicago in making the fair the success that it ought to be. The *Electrical World*, being a national journal, aims in matters of national importance to be as broad as the continent, and it will, therefore, be found to work as energetically for the success of the Fair in Chicago as it would have done had it been held in New York. We commend to electricians, electrical manufacturers, inventors and others connected with or interested in electricity, the necessity of timely action in the matter of preparation. In no single department of applied science will there be more interest shown or more good results attained than in that of electricity. The industry is new, the field is almost unlimited, and the world, looking on in wonder and admiration at what has already been accomplished by the aid of electricity, is eager to increase its meager knowledge of the nature and operation of the various electrical appliances. The World's Fair will offer an opportunity of bringing electrical apparatus, machinery and devices in a practical manner before all classes of the community, and also before many purchasers from abroad, that will not, we are sure be allowed to pass unimproved. Held in Chicago, the Fair will be national and international in its scope, and must be no less a complete exhibition of our products, industries, arts and manufactures. These great national fairs are educators, and develop commerce. The Centennial Exposition of 1876 operated directly as a stimulus to trade, both domestic and foreign. The World's Fair in New Orleans, although from its disadvantageous situation it did not score a success in point of attendance, exerted a decided influence in aiding the wonderful development of the natural resources and wealth of the new South, which for the past six years have attracted so much attention. To the Paris Exposition (the most successful ever held) is given the credit of reviving the flagging industries of France. In fact, many say that it has done as much toward enhancing the security of the Republic of France as any other political event in its recent history. Chicago will always be popular with electricians, and is already the center of no small amount of electrical work. Memories of the electric light convention of 1889 linger pleasantly with all. The hospitality of the Chicago Electric club will always be a delightful reminiscence. Having ceased to regard as a joke the pressing invitation extended by Mayor Cregier at the reception to the Eastern delegates while en route to Kansas City, electricians here will now cordially accept it. The *Electrical World* believing that the World's Fair, if held in Chicago, should be made a great national success, has subscribed $500 toward the fund being raised in its aid."

The Use of Electricity in Mines.[1]

By M. Chalon, C. E.

The applications of electricity to underground work are becoming so numerous that it is possible to predict that in the near future the electric current will be used nearly everywhere in the place of mechanical power. Even in coal mines, which are now so admirably equipped with mechanical appliances on account of the economy necessary in order to sell their output, steam, compressed air and water under pressure are being slowly replaced by the electric current. It may be employed for lighting at the bottom of the mine, and at the same time for a similar purpose on the surface, and for the communication by signals, and for the telephone. It will furnish at any depth, at different levels, and various distances, the motive force for underground haulage, by cable or inclined planes; for the removal of material thrown by blasting: for pumping water; for ventilation; for drilling; for coal cutters, and indeed, for running motors and machines of all kinds. All these many applications require only a dynamo, eogine and conducting wires.

It is in metalliferous mines that the application of electricity is becoming most valuable. Such mines usually possess many disadvantageous conditions for working, because they are almost always situated in districts that are not easily accessible, where fuel is expensive, and where transportation is an almost insurmountable difficulty. In such cases there is usually in the vicinity some waterfall, a swift river, or even a simple stream, whence the natural power may be transformed by the aid of a turbine and a dynamo, into currents of electricity which may be used for lighting, for the breaking and transportation of the ore, and even for the treatment of the ore at the mine by electrolysis or heat. In some cases, it is possible to sink an artesian well to produce an artificial waterfall by means of a reservoir more or less elevated. Indeed, it is possible to predict that the time is not far distant when it will be possible to work all mines with profit, especially those which from their inaccessibility have been thus far allowed to remain unproductive.

The use of the electric current for igniting charges of powder is perhaps the oldest application of electricity in mines. It is much more economical to fire charges by means of electricity than by the use of fuses. The comparison between the prices obtained from the ignition by the use of a gutta-percha fuse or by electricity is altogether in favor of electric fuses. If, in addition to the fact of its economy, that by the latter process perfect security from danger is obtained, a much greater advantage is gained, and, finally, a better utilization of the explosive material is

FIG. 1. ELECTRIC CIGAR LIGHTER.

secured in consequence of the simultaneous explosions; hence it can be safely accepted that the use of electricity is necessary, and soon will be used for all working in mines, especially in the excavation of shafts.

Lighting.—Electric lighting in mines consists of two kinds: First, permanent lighting by stationary lamps, and second, lighting by portable lamps. In the first case arc lamps are used for all work on the surface, while incandescent lamps are employed for underground work. It is underground that the advantages of electricity are particularly appreciable. The work becomes more sure, more regular, more rapid—and, a circumstance which seems strange to relate, it appears that the moral nature of the miner improves with the environment of an agreeable light. Permanent lighting is not applicable to the working faces. The use of portable lamps attached to the principal conductors, as was tried at first, is dangerous, and above all, inconvenient. The com-

[1]Abstract of paper read before the Mining and Metallurgical Congress, Paris.

ing in contact produces a spark, and besides, the moving of the switch-board offers considerable difficulty, as a false movement may crack the glass, break the cable, or expose the insulation. It is therefore necessary in the drifts and working faces to make use of a lamp that is independent of all conducting wires, easily transported, capable of being supended from the roof, attached to the walls, placed on the ground, or, in a word, a lamp that can be moved in all directions without losing its luminous intensity. To the same degree that the problem of permanent light is simple and easy to solve, so is that of portable lamps complicated and difficult. The following are the requisites for a good electric lamp for miners: It should first be of simple construction, and solid; second, as light as possible; third, easy to take care of and recharge; fourth, furnish a light having an intensity nearly constant for eight hours; fifth, having a lighting power of 1 to 1½ candle power as a minimum; and sixth, be inexpensive. In making comparison, we use as standard the Davy safety lamp (Clanny, Marsaut, Mueseler, Fumat, etc.), and it will be recollected that they are simple and solid, the weight does not exceed 1 to 1½ kilograms, that they yield a constant light from ½ to ⅔ candle for 10 hours, at an average expense of 15 centimes for each filling. One of the first portable electric lamps was that made by M. Trouvé, in which the generator of electricity is a bichromate battery, but the incandescence is only produced when the lamp is carred in the hand or suspended by a hook. Unfortunately the Trouvé lamp is heavy, its light is not steady, and it does not last longer than two hours. Numerous models of lamps, with primary and secondary batteries, were submitted to the English Commission on Accidents in Mines (1879-1886), but none received approbation. Since 1886, however, considerable progress has been made, and good accounts have been received of several lamps that are used in English mines, such as the Schanschieff and the Friedlander lamps, with primary batteries, and the Swan, Pitkin, and Higson lamps, using storage batteries. Swan has constructed an indicator which be adds to his portable electric lamp. He takes advantage for this purpose of the well-known property that red-hot platinum wire has of becoming more brilliant in a fire-damp atmosphere than in pure air. It is difficult to say which variety of portable lamp is the best. It is certain that in mines where there is already a good electric plant a lamp with a secondary battery may be used with advantage, but in all other cases a primary lamp is preferable. It is true, however, and must be said, that as yet no lamp with a primary battery, exists that is really practical and adapted to the exigencies of portable lighting in mines. The lamps actually in existence are far from fulfilling all of these desiderata. Some are too expensive, too heavy, too cumbersome, or have too great a resistance, while others contain corrosive liquids or are subject to electrical leakage.

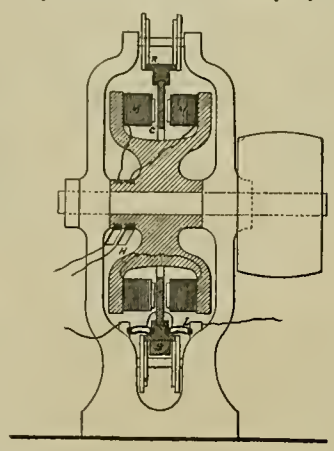
Signals.—In mines where an electric current is in use all of the working places in the mine and the surface are connected by bells or a telephone system. The code of signals is generally very simple, and consists only of one, two, or three bells. By means of signals and the telephone, a permanent and instantaneous communication is established between the bottom of the mine and the surface. The mine ceases to be isolated, and it may be said that all its movements, all its pulsations, are registered above ground. In cases of accident, aid may be called for and sent to the exact locality at once. The combination of signals, and the electric light in the workings, make possible a greater rapidity in the method of mining.

Machine Drills.—The operation of drilling by percussion with electricity offers great difficulty, but nevertheless; some interesting experiments have been made in the United States by the Sprague Electric Motor company, the Union Electric company, and various engineers. In all the experiments the bit is connected by a crank to the armature of an electric motor, in which every revolution corresponds to a blow struck by the tool. The application of an electric motor to rotary drilling, such as a steel cutter or diamonds, is much easier, for the motion of the armature may be communicated directly to the gearing that controls the tool holder. Taverdon has made some attempts in this direction with his diamond crown drill. Tedesco has also sought to apply the use of electricity to his drills.

Mechanical Cutting.—The electric cutting machine of Messrs. Bowes, Blackburn and Mori has been recently (1887) tested in England. The part carrying the tool-holder, which consists essentially of a plate provided with blades or knives in the form of a star, receives its force from an electric motor located in the same frame and having a force of 6 to 9 horse-power. This motor is connected by flexible conductors to a dynamo. The cutting wheel describes a quarter of a circle in a coal mass, which it cuts away to a depth of about a meter. The carriage is attached to a wheel and axle, by means of which it can be moved along the face. It is possible to dispense with attaching the motor to the carriage, but then it is necessary to move it by chains, or by means of a rope and pulley. The Lechner cutting machine tested in the coal mines of Pennsylvania is attached to an electric motor transmitting power by means of a cord. A single motor will do the work of three cutting machines operating successively, thus permitting continuous working, for while the second or third cutting machine is in operation, the coal cut by the first can be loaded.

The Ferranti Alternating Current Motor.

It is well known that an alternating current dynamo may be used as a motor on an alternating circuit, and it will run synchronously with the alternations of the current—that is, each part of its armature will pass from in front of one magnet pole to in front of the next magnet pole of opposite polarity coincidently with the alternations in the current. Practically, however, such a machine cannot be used as a motor without means being provided for readily revolving the armature and bringing it up to a speed to coincide with the alternations in the current. The reason for this is that the machine does not develop power until this movement synchronizes with the reversals of the current. In that type of the Ferranti alternating current motor, which is represented in the accompanying cut,



FERRANTI ALTERNATING CURRENT MOTOR.

the armature and field magnets are both made on one axis, capable of revolving on concentric axes, so that one may be revolved without doing work. When the armature is moving synchronously with the current it may be gradually arrested by a brake, while the field magnets on the driving axis of the machine start gradually, the relative movement between the two being always maintained the same by the current.

Reference to the diagram will show the general construction of this machine. The armature is made up of flat coils, which are carried within a ring *R*. This ring rests between pairs of flanged rollers, *P*, placed at intervals around its circumference so that it can revolve freely. *M* and *M* are two circles of electro-magnets on the two opposite sides of the armature, with their poles ranged alternately north and south. These are carried by an axle, which is concentric with the ring *R*, and carries the motor pulley. *B* is a brake-block, which can be pressed against the ring *R* to stop it from rotating. This ring carries two insulated conducting rings, one of which is coupled to one end of the conductor of the armature and the other to the opposite end of the conductor. Against the rings are pressed rubbers, which are coupled to the main conductors and convey an alternating current to the armature coils. The axle also carries two insulated contact rings at *H*, to which a continuous current is conveyed by brushes. By this arrangement the current passes from one ring through the coils of all the field magnets *M* to the other ring.

The operation of the motor is as follows: When the field magnets are excited by continuous current, and the alternating current is supplied to the armature conductor, the armature is started in motion by hand. The armature can quickly be revolved at the required speed, as it is very light, and when moving at the speed at which the current will drive it, will be kept revolving by the current at this speed, the magnets and the axle which carries them remaining practically at rest. Now if the brake-block be gradually pressed against the ring *R* the armature will be gradually stopped and the magnets and axle will commence to revolve and will gain in speed as the armature loses. When the armature is absolutely stopped the axle will be up to speed and the motor will be in a condition to perform work. It is proposed by Mr. Ferranti that the field magnets be excited by current from a secondary battery, and that this battery may be charged by means of a dynamo, driven by the motor from time to time when it is at work.

New Excelsior Constant Current Generator.

The cuts presented herewith illustrate a new type of electric generator, which has recently been placed on the market by the Excelsior Electric company of New York. In general design this dynamo is a radical departure from the well-known type of Excelsior arc machine, and it embodies a number of novel and interesting features. The generator was built to run at a speed of 700 revolutions per minute and supply 80 arc lamps, or an equivalent in motors, with a current of 10 amperes. In proportioning this machine, an effort was made to attain the closest regulation under great changes in load. The necessity for this last-named feature which, it is stated, the machine possesses to a remarkable degree, will doubtless be thoroughly appreciated by those who have had experience with constant current dynamos supplying current for

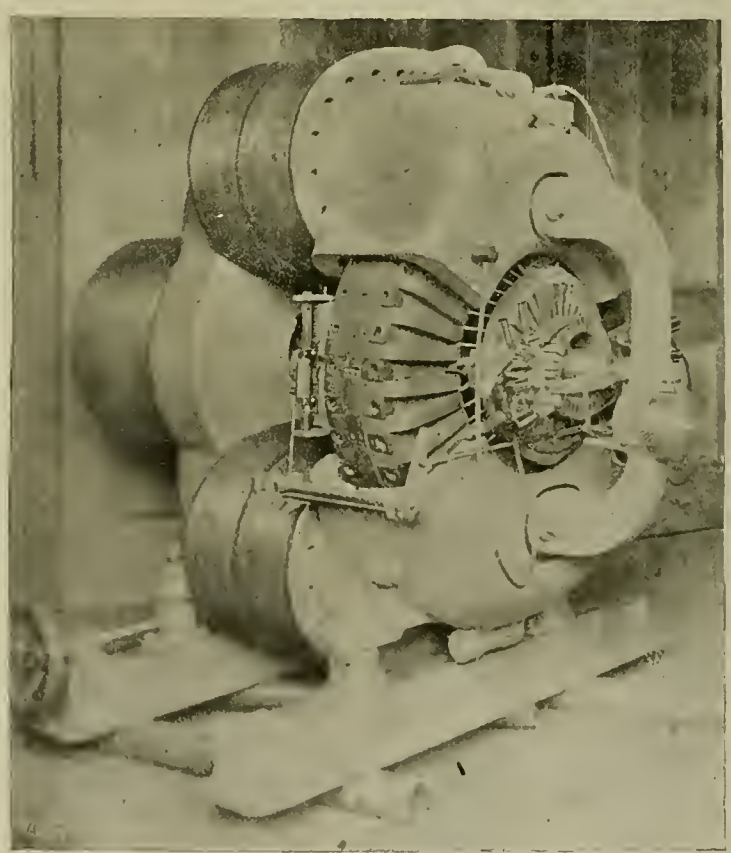


FIG. 1. NEW EXCELSIOR CONSTANT CURRENT GENERATOR.

both arc lamps and motors. The two illustrations represent the machine complete with the exception of a small controller. While the general method of regulation of this machine is the same as that employed in the old type of Excelsior arc dynamo, the regulating mechanism has been greatly modified. By this change, together with the remodeling of the body of the dynamo, an entirely new machine, practically speaking, was produced.

In the ordinary type of Excelsior machine, regulation is effected by varying the strength of the field magnet, and at the same time revolving the brushes around the commutator. This, as it is well known, is accomplished automatically by means of a small motor, whose direction of rotation is controlled by an electro-magnetic device, which responds to changes in the strength of current on the line. With this new type a wall controller is also used. This operates as the current on the line varies from the normal 10 amperes, to send a current through the armature of the motor in such a direction that the brushes will be revolved, and the intensity of the magnetic field changed in a manner as will hereafter be described. On the new machine the motor is concealed in what might be described as a brass case just opposite the front end of the armature shaft. In order to better understand the arrangement, it may be well to state that the two bearings for the armature shaft are both on the further side of the body of the armature. The yoke, therefore, which extends from pole-piece to pole-piece constitutes the field magnet for the motor, and has no mechanical connection with the armature shaft. Connection between the motor and brush yoke is made through a train of gears. Each limb of the field magnet of the dynamo is wound in two sections, as indicated in the cut. That portion of the coil on each limb, which is nearer the hinged pole piece, is divided into sections which connect with the row of copper contact pieces shown to the left, just back of the armature. A metal piece is arranged to be moved over these contacts and according to its position cut in or out the sections of the field-magnet coils. This "cut out block" connects, as shown, with the brush yoke. A most important feature of the machine is indicated in Fig. 2. A glance is sufficient to reveal with what ease an armature might be removed from the machine. An absence of excessive sparking under changes of load is another noticeable feature. A generator of this type has recently been installed by the western department of the Excelsior Electric Co., in the station of the Chicago Arc Light & Power Co., and, it is claimed, the machine is doing excellent service on both lamp and motor circuits.

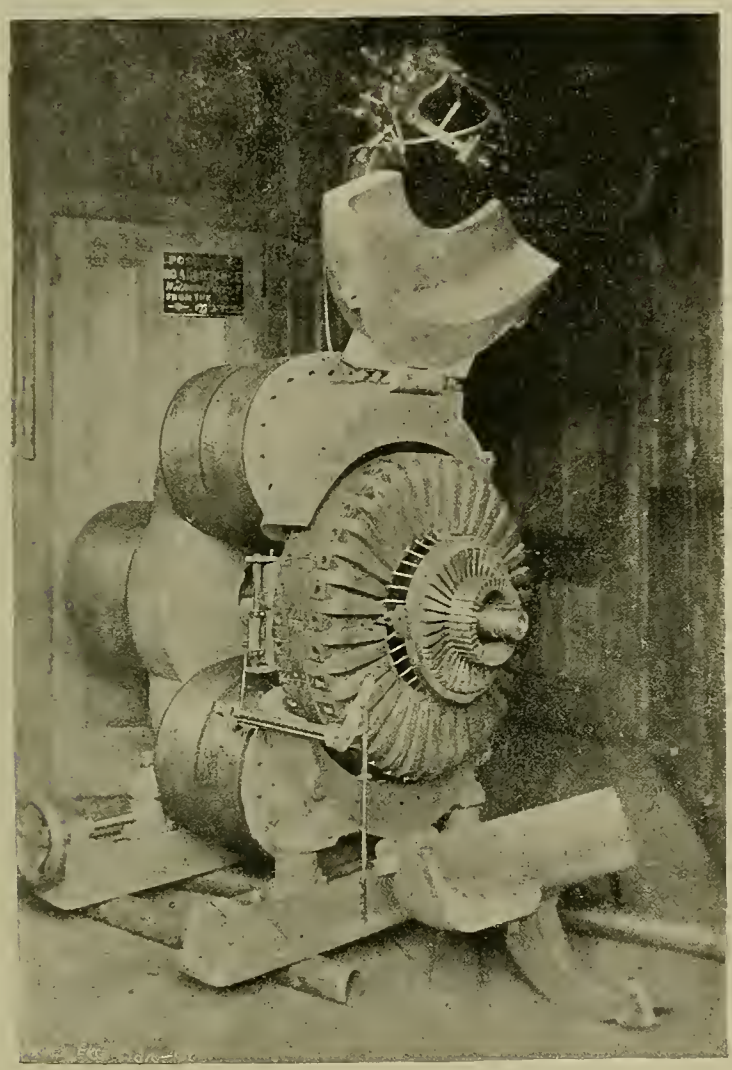


FIG. 2. NEW EXCELSIOR CONSTANT CURRENT GENERATOR.

A Theory of Accumulators.

At the last meeting of the Chicago Electric club Dr. Paul Schoop's paper on "A Theory of Accumulators," was presented. The paper appeared in the last number of the WESTERN ELECTRICIAN.[1] After the reading of the paper, the following discussion took place:

MR. PUMPELLY: The suggestions that the doctor has presented to us in this paper seem practical. There are facts in the paper that can be easily proved, and a part at least of his theory; for instance, in reference to the absorption of hydrogen. It is well-known that after charging a battery to its full capacity, that is, as far we can get it by theory, the electromotive force may be over two volts; perhaps two and four-tenths even for a few moments, when the current is turned on. Why? Evidently because there is a superabundance of hydrogen in the kathode which acts as electromotive force. Don't you think that is so doctor?

DR. SCHOOP: The lead-sponge is saturated over its normal capacity if the potential is higher than two volts. It loses this high potential only when a certain amount of current corresponding to the amount of the normal absorption power has been taken out.

MR. PUMPELLY: Now, that is almost proven by actual experience. Plante, who spent years of study on the subject, says that as far as he can learn the most commercial metal is lead. It may be possible that when aluminum is sold at 25 cents a pound we may be able to get a light battery which has as great an efficiency as lead. I do not think we will get a more efficient battery, but we will get a much lighter battery. We want a battery of which we can say, "Do so and-so, and such will be the result." At present we are all trying to make a storage battery that will run a street car. It is not made yet, and I do not know when it will be made, but we are all trying to do it.

PROF. CARHART: I have had some experience with storage batteries and some that has not been altogether satisfactory, I am sorry to say. I have no doubt that there is a good deal of truth in the theory that the writer of the paper has advanced, but I cannot accept it fully. There seems to be a great many facts on the other side. I did not notice any reference to the quite exhaustive work of Gladstone and Trybe on the chemistry of storage batteries, in this paper. It will be remembered by some of you that the latter, by methods which are regarded, I think, as legitimate in chemistry, made a chemical analysis of those plates which seem to prove beyond controversy that one of the plates was sulphated during discharge, and was again reduced during the charging process. It is a long time since I have looked at it, but if I remember correctly it stated that the sulphate of lead could be reduced by hydrogen, a process which the theory seems to require. I have made a study of this point, but it does not appear to me that the propositions the gentleman has advanced, are sufficient at least, to say that it is a new theory.

One other point occurs to me which has been referred to already, the high potential which is observed immediately after charging the storage battery. I supposed that it had been quite generally admitted this high potential was due to the small amount of hydrogen and oxygen absorbed by the two plates. Undoubtedly the absorption of hydrogen on one and oxygen on the other contributes to this high electromotive force. It lasts, as you know, only a short time. The potential drops to its normal value after the circuit has been closed for a brief period. It appears that during that brief period while the electromotive force is higher than its usual value the hydrogen and oxygen would contribute to the high potential. It does not appear to me that beyond that point the absorbed hydrogen serves any special function.

I will state a little of my own experience. I have a battery of 31 cells. Their represented capacity is 125 ampere-hours. They had that capacity, I think, when I first obtained them, but after treating them some time, because they had become dry from standing, they were not in any way satisfactory. They never have buckled, but to all appearances they have lost a little of their active material, because there is a small collection of material in the rim of the cells, which has to be knocked off occasionally to prevent short-circuiting. Those cells have been in use only a year, and at present they have not a capacity exceeding about 18 ampere-hours. They have been treated with very great care—nursed I may say, to prevent any accident happening to them. They have not been overcharged, except once or twice slightly. I know of no explanation for their loss in capacity except the fact they have not been used enough. They have been charged and left standing too much perhaps. I have written to the company about them, but do not get any satisfactory answer. Certain reasons are proposed to account for this loss of capacity, but they are not reasons which apply to the battery, unless it be that the cells have sulphated more than I supposed they had. There is no great appearance of sulphate. There is a little scattered over, but the fact remains that the electromotive force has fallen to about 54 or 55 volts for the 31 cells, with a current at the beginning of not more than 15 amperes, and reduced somewhat in the space of an hour and a half; the outside shells will boil so much with a current of not more than 8 amperes, that it is impossible to keep up the current. I should like an explanation on this point why these cells have depreciated so much in value.

DR. SCHOOP: I wish to say in answer to the remarks of Prof. Carhart, that I did not refer to Gladstone and Trybe because in the books of Salomons and Reynier, the valuable researches of these investigators are referred to. I certainly have no desire to withhold the names of any persons who have supported the sulphate theory, and their names are numerous. It will be remembered that I spoke of Prof. Frankland, whose researches are the latest in this department. Prof. Carhart says it has been stated that the sulphate of lead can be reduced by hydrogen. As no other forms of sulphate of lead, beyond the white sulphate, have been obtained until the present time, at least, in such a state as to indicate a definite new compound, I infer that his remarks have reference to the white salt. It is found, by investigators, that this salt cannot be reduced to metallic lead by the mere action of hydrogen in dilute sulphuric acid; while others are responsible for the statement that a reduction takes place, but very slowly. I have found that white sulphate of lead is exceedingly difficult to reduce by making it the kathode in an electrolytic vessel containing pure sulphuric acid; but weeks and months elapse before it is possible to detect the slightest reduction. If the battery of Prof. Carhart has only lost a trifle of the oxides and still the capacity of the cells has diminished to about 1-10 of the original capacity, this seems to me to be proof that the active material has changed into real sulphate of lead, as this substance is acted upon only incidentally in the ordinary charging, as I stated in my paper. The black compound on the anodes in a charged cell is not changed by dilute sulphuric acid; but the chocolate-brown substance which is on the anodes after the discharging of the cell combines more readily with the sulphuric acid forming the sulphate of lead. A battery should never be left standing in a discharged condition for any considerable period. This most important of all rules for the care of storage batteries is contained in the directions of every manufacturer. The facts which Prof. Carhart presents in regard to his battery, support, it seems to me, the theory which has been advanced here this evening. They prove that as soon as sulphate of lead is abundantly present in the plates of a cell its storage power is gone. I have not asserted that the theory which has been advanced is new, inasmuch as it was the outgrowth of Faraday's suggestion.

[1] Several inaccuracies occurred in Dr. Schoop's paper, as published last week. In the first column on page 148, in the description of Figs. 1 and 2, the letters A and B should have been transposed. In the second column the sentence in the second paragraph should have read: "For each pound of water formed in this manner about 1400 ampere-hours are delivered."

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
P. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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In another column is presented an interesting article by Force Bain on the "Mystery of Electricity." While not denying that electrical phenomena are in a certain sense mysterious, Mr. Bain comes to the conclusion that the mystery of electricity is no more profound than that of steam; that the theory of the dynamo is as readily understood as that of the steam engine.

An interesting illustration of the peculiar adaptability of electricity as a motive power, will be found in the description of an electric carpet-sewing machine presented in another column. Briefly, the apparatus might be described as a sewing machine, so arranged as to travel along the edge of a carpet, sewing as it moves along, and driven by an electric motor taking current from overhead trolley wires. The details of the machine have been most ingeniously worked out, and its simplicity is a noticeable feature. The apparatus will doubtless be somewhat of a revelation to many in the carpet trade.

The electrical press of the country has received a great many compliments on the enterprise displayed in reporting the Kansas City convention of the National Electric Light association. The New York weekly electrical papers however, up to the present time, have not printed the entire proceedings. One of the journals in that city is printing an abstract of the report in serial form, and the other has omitted altogether one of the most important papers. The following paragraph is taken from our esteemed contemporary, *Practical Electricity*, of Boston.

"Our enterprising contemporary, the WESTERN ELECTRICIAN, certainly deserves a good-sized medal. The Kansas City convention closed its proceedings on the 14th of February. On the 19th, a copy of the ELECTRICIAN was received at this office, containing a full stenographic report of the proceedings, together with all the papers that were brought before the meetings. Nothing affords us more pleasure than to recognize enterprise and push when they come so manifestly to the front. What is the matter with our New York journals, that they were so far left behind?"

The utilization of the electric current from central stations for various purposes outside of light and power service, is becoming more and more general. It is a noticeable fact that there is a gradually increasing demand for current in comparatively small quantities. Electric light plants in the larger cities are kept running day and night, and the current is therefore "on tap," so to speak, at any time during the twenty-four hours. This fact is beginning to attract the attention of many who have hitherto been supplied from other sources. Among those who have recently found it advantageous to utilize the current from a central station system in preference to the employment of a number of isolated generators, may be mentioned the Chicago Telephone company. This company now rings the greater number of the magneto signal bells by current taken directly from the mains of a well-known incandescent central station system. The apparatus by means of which the continuous current is commuted and may be sent out over the lines as an alternating current, is described in another column. The simplicity of the commuting device is its most noticeable feature.

The use of electricity in mines is becoming of the greatest importance to the electrician. It is a common prediction that in a few years mines will require the attention of electrical engineers to a far greater extent than any other field. Such views are not confined to this side of the Atlantic. In another column is presented an article on the use of electrical apparatus in mines by M. Chalon. The paper was read recently in Paris. The writer emphasizes the advantages attending the use of electricity for illuminating, breaking and transporting ore, and for the electrolytic treatment of the product of mines. He speaks of the last application as of minor importance, but in this respect all American electrical engineers would not agree with him. Many predict that in America at least the electrolytic treatment of ores will form perhaps the most important application in mining. By way of prediction, M. Chalon says that "the time is not far distant when it will be possible to work all mines with profit, especially those which from their inaccessibility have been thus far allowed to remain unproductive."

In another column is given an abstract of a paper read by Dr. Amory before the New England Gas association. He gives reasons why gas and electric light plants should not be owned and operated by municipalities. He thinks that the business should be in the hands of private corporations, and he is doubtless correct in his views. Not every one, however, would admit their correctness. A writer in the March *Century* takes up the question incidentally in an article on "Glasgow: a Municipal Study." In that city the gas works were transferred from private hands to the corporation about twenty years ago. During this period the consumption of gas has increased 140 per cent. and the price has been reduced about 40 per cent. It is stated that good management has wrought such changes that only 10 per cent. of the gas is lost in leakage. That is still a sufficient escape, it would seem, to make it interesting for companies which might own subways in Glasgow. This subject of the ownership of illuminating plants is one of great interest to those who are investing their money in central stations. As a rule, we think such plants should be controlled by private corporations. There may be exceptional cases, but the rule holds good. The aldermen of Boston took this view of the case a few nights ago when they very sensibly shelved a measure providing for the purchase of a city electric light plant.

In the *Century* article, to which reference has been made, it is stated that Glasgow has had an interesting experience in lighting common stairs in tenement houses. It is said that stair lighting costs the city more than street illumination. The experiment has proved successful in an eminent degree, and has resulted in a marked decrease of crime. The use of incandescent lamps would probably be even more effective. Electric lights might be used with good results for such a purpose in many sections of large American cities. New York's experience in darkness has shown how great a protection is the electric light.

CHICAGO has been chosen as the site for the World's Fair. The choice is satisfactory to a great majority of electrical workers throughout the country. Looking at the matter from a purely business standpoint, they have come to the conclusion that they would be more substantially benefited by a World's Fair held in Chicago than an international exposition in any other city in the country. There is an enormous amount of work to be done by way of preparation for the exposition, but it is only fair to say that the Chicagoans who have the matter in charge express the utmost confidence in their ability to complete all arrangements within the required time. Whether they particularly appreciate the fact or not, the representatives of electrical interests of this country will soon have a mighty responsibility put upon them. The most important feature of the exposition will be the exhibition of electrical apparatus. It must be complete in every department. Americans saved the electrical exhibit of the Paris exposition from being a complete failure. They will now be expected to show what they can perform when they have an ample opportunity for making a display. Throughout the world Americans are recognized as distinctively practical electricians. They will be called upon to maintain that reputation by a magnificent exhibition demonstrating by apparatus in actual operation, what has been accomplished by American genius. This is the responsibility which will be laid upon the representatives of American electrical interests, and we doubt not that this enormous task which the public demands of them will be performed in such a way as to reflect credit upon themselves, and upon the nation. The World's Fair of 1892 or 1893 will doubtless be the most important international exposition ever held, and the electrical exhibition will be its crowning feature. As we have already said, the great majority of the electrical workers has from the first favored Chicago as the World's Fair city. Those who did not, now that the question has been determined, will doubtless be as energetic in advancing the interests of the fair in the western metropolis as if the city of their choice had been named. This liberal spirit is manifested in an editorial in the New York *Electrical World*, which is quoted in another column. We are glad to see that the *World* rises above the petty spite which is so marked at the present time in the metropolitan dailies, and proposes to do its part in making the World's Fair in Chicago a magnificent success.

The *Scientific American* falls into line also and says, "The fair will apparently drop down upon Chicago almost self-made, under the magic touch of her enterprising people. But we hope this may prove true, and that Chicago will show to the world she really deserves the proud distinction she claims, that of being the most liberal, practical, and active city in the world." There is every reason to believe that Chicago will sustain its reputation. Its enterprising citizens are preparing for an exposition which will surpass all of its predecessors.

The Mystery of Electricity.

By Foree Bain.

Nature is motion's mother,
The spring whence order flows; that all directs,
And knits the cause with the effects.

In viewing the question of mystery as pertaining to electricity, we can only treat the subject relatively. Webster's definition of mystery is "that which is beyond human comprehension until explained." It is not my intention to try to present a full and lucid explanation of just what electricity is, or to inculcate the belief that there is no mystery in connection with the manifestation of that peculiar form of energy known as electricity. The manifestation of that invisible, and we may truly say mysterious, mother of motion, which makes itself known to us in the form of one of the various modes of motion known as heat, light, electricity, magnetism and chemical affinity, is in itself a mystery. Our every-day experience teaches us to form our ideas on a materialistic basis. If we wish to draw a vehicle over a road or rail we have found that it is necessary to make a mechanical or material contact with the vehicle. The phenomena of action through space,as illustrated by gravity, induction, magnetism, chemical affinity, etc., are by no means understood, and notwithstanding the great advances of the last few years the dark mists of doubt and ignorance yet hang like a pall over some of the secrets of nature, which will only be cleared away by the penetrating sunshine of a higher education. Until we can comprehend the causes of all these effects, our consciousness, not knowledge, can only be relative; for instance, in the endeavor to comprehend the existence of heat, it is necessary that we should know something of the sensation of cold. Darkness, we are taught, is the absence of light, hence, we could never have known of the existence of light if we had never known of darkness, and thus by this method of relation, we are able to satisfy the mind in regard to a few of the vast problems of nature.

It is sufficient for this article to accept the theories of our most recent philosophers. Until the close of the past century the profound philosophy of the most erudite students of phenomena was only speculative. About the beginning of the present century the great principle of the indestructibility of matter was announced and it was demonstrated by Joule, Faraday and others, that the great principle applies also to the *forces* of nature. To those who do not understand the principles of the theory of the conservation and correlation of energy, let me say that it is the foundation upon which all modern science is based. Heat, light, electricity, magnetism and chemical affinity are no longer regarded as having independent existences, subtile fluids with peculiar properties, but simply as modes of motion in ordinary matter, forms of energy which are capable of mutual conversion. Heat is a mode of motion manifested by certain effects; it may be transformed into another mode of motion, electricity, which manifests different effects. Electricity may then be transformed into still another mode of motion, light; and light into chemical affinity, and so on *ad infinitum*.

Chemical affinity is probably the least understood of all the modes of motion. Its action so modifies and alters the character of matter that the changes induced thereby are called chemical affinities in contradistinction to physical changes. Water in process of freezing expands; the expansion is a form of energy which is one of the manifestations of chemical affinity. It is a process by which the heat contained in the water is transferred by chemical affinity into motion. The arrest of motion is force. If the water be confined in a vesel composed of a material not capable of withstanding the expansion of the liquid, then the force which is developed will break the vessel. If the vessel is capable of withstanding the pressure then a certain amount of force will be developed which again will be converted into heat by the compression of particles due to rapid expansion. Now should the water be confined in a rubber bag or other flexible vessel which will readily yield to the rapid expansion then the resultant effect will be to increase the cold, as there is no further conversion of this motion into another form of energy. As resistance to motion or friction develops heat, therefore without the resistance there would be no heat, as an effect of motion.

Bearing these facts in mind let us see whether we cannot be convinced that there is no greater mystery in electricity than there is in steam; in the dynamo than in the engine. Coal possesses that element of power or motion known as potential energy, that is by certain processes it may be converted into other forms of energy. When coal is put under the boiler, heat is developed by a process of chemical affinity known as combustion. The heat is applied to the water which in turn is converted into an elastic aeriform fluid, steam. The process of converting water into steam, is one of expansion or it may be, that the water through the application of heat loses a part of its cohesive attraction and its particles exerting a mutual repulsion, tend to occupy more space. The confines of the boiler hold the particles of steam in a strained state of potential. When a clock is wound up the spring is in a state of potential, that is, it has the power to do work when released, so the steam, wound up as it were, by heat is conveyed to the cylinder of an engine and there released. The piston is driven out, when the steam is ejected into the atmosphere, and another supply of steam drives the piston in the opposite direction. These reciprocations of motion are easily converted into a continuously rotary motion. It may be thought that the processes that set a steam engine in motion are easily understood because the agencies that accomplish this effect can be seen. Such however, is not the case. It is not the steam that does the work; it is the condition that has been conferred upon the steam by the process of the conversion of heat into motion, that causes the engine to move; steam simply acts as a vehicle by which these transferences can be accomplished. A mainspring will not keep a clock in motion unless its condition is favorable. It must hold in potential strain, the energy necessary, and steam without this potential energy will not move an engine. Therefore, by analogy it follows that it is *not* the steam that does the work.

There is in all nature a tendency toward equilibrium, an effort to restore all matter to a natural condition. If, as in the case of steam, matter has been subjected to an unnatural condition, the effort of nature will be to restore it to its former or normal condition. As a further illustration, if we bend a tree so that its top may touch the ground, it will require energy to perform this operation, but nature will give back the energy in its effort to return the tree to its former position. Water flowing over a dam may turn a wheel by which machinery may be set in motion, or by which electricity may be evolved. This is an effort of nature to restore an equilibrium. The water in its elevated position is in a state of potential. The water itself does not cause the wheel to turn, but in its effort to satisfy the condition of equilibrium, gravity acting through the agency of the water, as pressure acting through the agency of steam, causes the motion. In the former case sand would answer the purpose as well as water, when acted upon by gravity in the same way, and gas or air under the same conditions as steam will drive an engine.

Now let us see how electricity is generated? First let me make the statement that I believe that all matter is in a state of electric equilibrium, which is co-existent with matter; that it is in a static or latent condition, just as all matter is surrounded by a certain definite pressure, due to gravity acting upon the atmosphere. To make my meaning clear, let me illustrate: If I take a tube and by means of a suitable suction pump decrease the pressure at one end by extracting a part of the air or atmosphere, the pressure there, in will tend to equalize and more air will rush in at the other end of the tube to satisfy the disturbed or destroyed equilibrium, and this will continue until the equilibrium is established. Let us suppose that we have the elements of a battery and a complete metallic circuit; we will include in this circuit a galvanometer which will show the direction of the current. Our elements are copper and zinc, the — and + elements respectively. Without an electrolyte there is no deflection of the needle, and yet the entire circuit contains as much electricity, if the expression may be allowed, but in a state of equilibrium or balance, as it will after the excitant has been introduced. Like pressure, it is in a static condition, equalized on all sides and consequently, since there is no "difference of potential (an electric term) existing, no current will flow." It is the difference of potential between the inside of a boiler and the atmosphere, produced by chemical affinity, that causes the engine to move. Now let us pour into our battery the excitant. Immediately we will notice by the galvanometer in which a portion of the electric energy is converted into magnetism and motion, that a current of electricity is flowing. Is there any mystery connected with this phenomenon? The excitant has established a chemical relation between the zinc and copper. What the exact nature of the transference of chemical power across an electrolyte is, we do not at present know, nor have we any exact knowledge as to the nature of chemical action. For the present, we must leave it as an obscure action. We know however, that an equivalent or proportionate electrical effect is produced by a given amount of chemical action, the result of which is to cause the electric condition of the zinc end of our circuit to fall below the normal electrostatic pressure and that of the copper end to rise above the normal, and hence the effort to equalize the electric potential of the entire circuit will cause the flow of electricity from the higher to the lower condition. The battery acts in this case just as the pump would act upon the air in the pipe or tube. Without going into the details of electro-magnetic induction,let us see whether we can determine how motion is converted into electricity by means of a dynamo. First, we must know what a dynamo is. Abstractly it is a machine for converting motion into electricity; concretely it is composed of bundles of insulated wires wound around properly disposed masses of iron. It has long been known that when a magnet is brought near any metallic substance so that the latter will cut the lines of force of the magnet, a current of electricity will be produced. This phenomenon is accompanied by a resistance to the motion of the magnet or the body and this resistance tends to bring the moving mass to a standstill. The current evolved by a metallic body, cutting the lines of force of a magnet, is a manifestation of a physical force known as induction. It is to induction that we are indebted for the dynamo. Suppose I have a permanent magnet and a small copper thimble like a spool, having an iron core through the center, now if I cause this to approach a certain end of the magnet, a current of electricity will flow around the copper thimble. During the time that the copper thimble is in motion in the vicinity of the magnet or while the magnet is in motion in the vicinity of the spool, we may multiply the pressure of the current flowing in the spool by multiplying the number of turns around the core. This can be more conveniently done by using insulated wire. Copper is used because of its comparatively low resistance and therefore there is in copper comparatively little heat evolved by the passage or flow of the current.

The object of the iron core is to concentrate the lines of force of the inducing magnet. In practice a continuously rotary motion is more economical than a reciprocating motion. therefore, we wind the coils of wire on a drum or ring and rotate it for mechanical reasons instead of reciprocating it as referred to in the example. The manifestation of electricity in coils of wire maintained in motion in the neighborhood of a magnet, is due to induction. A magnet acting upon moving coils through space disturbs the electric equilibrium and causes the current of electricity to flow from a higher to a lower potential just as gravity acting on the atmosphere causes air to rush in one end of a pipe when air is taken from the other end. Hence it is no more difficult to comprehend the action of induction than it is to understand the manifestations of gravity. That it seems more difficult to understand induction arises from the fact that we do not number an electrical sense among our senses, and therefore, we do not possess an intuitive perception of electric phenomena. During childhood we had years of unconscious experimenting with the other forces of nature.

connected with the sensations of light and darkness, heat and cold, lightness and heaviness, contraction and expansion, but we knew nothing of the force of electricity. We begin life as experimental philosophers with regard to the other forces of nature, and the long association seems to divest them of mystery, but as a matter of fact, there is no greater mystery in the manifestation of electricity than there is in gravity. We must begin the study of it as a child, as we began the study of gravity and all the other more familiar forces.

Rae Motors at Decatur.

The attention of the croaker on the *Pacific Lumberman* is invited to the appended item concerning the operation of the Rae motors, supplied by the Detroit Electrical Works at Decatur, Ill. The clipping is from a local paper, and written by a person on the ground. We believe the Rae system is now giving satisfaction wherever it is in use, the *Pacific Lumberman* to the contrary, notwithstanding:

The first of the new motors of the Decatur electric street railway was run out yesterday, and it worked excellently. Once or twice it was necessary to stop to oil the journals, but the motor did excellent work. It took on all the current which was given it without sparking, and got up and walked away with the car in a way that was surprising. Up grade the speed did not diminish. Stopping and starting on a curve the motor showed its power. Once or twice when the current was turned on suddenly the car jumped forward at a fast pace, the limit switches at the power station were turned out, but the motor took the current without a spark. F. B. Rae, the inventor, had the car in charge. The car is as noiseless as it seems possible to make a street car, and the working is apparently as satisfactory as that of any other motor. The truck is as good as it can well be made. The new trolleys are excellent in every way. The wheel journal is surrounded by graphite put in by hydraulic pressure, and is thus self-lubricating. The wheel is held in place by clamps in such fashion that if the trolley jumps the wheel falls to the ground upon striking the first guy wire, thus obviating the danger of tearing out the trolley stands. As the car ran with rapidly accelerating motion, E. J. Martin lifted up his voice and whooped. He is only anxious to get the franchises for proposed extensions, so that the road may be made long enough to run with profit. He is now intending to prepare for the summer business, and says that he can easily hitch on trailers to the new motors. He is looking for a new era in the business of his line. When all four of the new motors are in working order, he will run three cars under the five minutes' headway between Lincoln Square and the Union depot, leaving one car for North Edward street business.

Municipal Control of Gas and Electric Lighting.

During the recent meeting of the New England Association of Gas Engineers, at Boston, Mass., Dr. R. Amory, of Brookline, Mass., read a paper on "Municipal Control of Gas and Electric Lighting." His experience, he said, indicated that better service and rates were obtained when the illumination was done by commercial companies. He cited the experience at Dresden and Munich where the government controlled the gas works, and the rates were so high and the service so poor that only a small percentage of the city was illuminated by gas. At present there is a general movement for placing gas and electric lighting under municipal control. Dr. Amory said: "The present outcry is to save the payment of profit to private capital invested in gas undertakings by means of the municipal ownership and management of new plants built upon more modern processes of gas manufacture; and hence, supposed economy in cost of manufacture.

"My purpose is to show the fallacy of this popular outcry, for I doubt if we appreciate how strong this demand is growing; and yet we know that the result of acquiescence and submission to this sensational effort will be as in private competition a duplication of invested capital to supply consumers within the same geographical limits. We all must recognize the fact that the same axiom prevails in our business as in other mercantile undertakings. The man or company that can make the largest sales of daily commodities can afford to do this at a smaller margin of profit than his competitor who makes small sales at larger profit. Long bills of sales and small profits will result in turning over invested capital more frequently every year; for instance, one cent made out of a dollar used ten times a year makes 10 per cent. profit during the year. We see an exemplification of this in the larger drygoods and grocery stores in our more populous towns. These do so much more business on capital invested that the small shops disappear very rapidly, and the large shops grow annually larger. Apply this principle to a city which lights its own streets from municipal gas works and consequently makes small sales at less profit. The same main which carries the gas of the private corporation to the shops and houses of its people could just as well supply gas to the street lights, and the private corporation can afford to do this at less cost on account of the larger amount of gas manufactured."

Dr. Amory advises gas plant managers to make concessions to the municipalities and avoid the controversies otherwise apparent. In conclusion he adds: "I again repeat that we as gas managers must down this monster of public opinion by concessions, and must try our luck at economy of management to increase our prospects of small earnings. We must do this by offers to light public streets and buildings at the lowest possible cost, or else suffer the consequences. The lamentable exhibition in Boston of a disposition to crowd down the throats of the civic authorities a reasonably large price for street lights and for public buildings has resulted in a cat and dog fight which would be ridiculous if it were not dangerous to our existence. The older gas companies have profited by a long experience in meeting this issue. I sincerely hope that our younger brethren in the electric light business will copy our policy, and thus put an end to the popular demand for municipal gas and electric lighting."

National Fast Telegraphing Tournament.

Fred Catlin, manager of the fast telegraphing tournament at New York, announces the allotment of prizes as follows.

Class A.....	First prize,	$100.	Second prize,	$75
Class B.....	"	85.	"	65
Ladies' Class.....	"	50.	"	40
Old Timers.....	"	50.	"	40

The interest in this tournament is shown in the following excerpt from a communication from A. B Chandler, president of the Postal Telegraph Cable company: "I am much interested in all that tends to improve the work of the operating department of the telegraph, and have no doubt that the trial of skill which you inform me is to take place in this city next month, will stimulate the efforts of all operators to excel in their profession. I inclose herewith our company's check for $50 in furtherance of that object. I do not find any reference, either in your letters or the printed notices on this subject, to any other feature of skillful work than that of fast sending. Desirable as it is to attain high speed in transmission, it is still more desirable that the work should be strictly accurate, and the copy of the receiving operators clean and in right form. I have no doubt that this is well recognized by all operators who are sufficiently expert to take part in such a test as is proposed to be made; but, for the benefit of the younger operators, and of the telegraph service, I take the liberty of suggesting that, in dealing with this subject, its promotors shall make it plain that a firm touch, and absolutely correct work and clean copy, are to be sought for, as well as swift sending. I will give a prize of ten dollars ($10) to the operator who in this trial shall be adjudged to be the clearest and best sender regardless of speed; and another prize of ten dollars ($10) to the receiving operator who shall make the clearest and best 'pen and ink' copy including all the 'earmarks' required for the identification and record of messages."

In relation to this mode of receiving, Mr. Catlin explains: "The matter has been thoroughly canvassed and the opinion expressed by a large number with whom I have consulted, that it is only in rare cases where an operator on trial, under the critical inspection of hundreds of experts, has sufficient control of his nerves to make a creditable showing Some of our very best operators, under the severe trial would fail, while in a less conspicuous position they would copy these rapid transmissions with ease. It is largely a question of nerve. Arrangements have been made to have the transmissions received by an expert typo-telegrapher and recorded on the caligraph. However, should any operators desire to compete for this prize and the honor attached, the opportunity is offered them." The prize offered by Mr. Chandler for the best transmission regardless of speed will also be placed before contestants.

Practical Working of the Electrical Subways of New York City.[1]

By William Maver, Jr.

Part III.

JOINTS.

When it was being urged upon the electric light companies of this city that they were not using due diligence in placing their wires underground, the companies retorted that they were doing so as rapidly as it was possible, consistent with good workmanship, and they cited the fact that it was not possible to joint up the cables more rapidly than was being done with the number of capable jointers at their command. To this an official of the city replied that this did not, in his opinion, constitute a valid excuse, while so many poor men were idle who would be only too glad to be given work at jointing the cables.

This was the view of a layman, but it would seem that in a number of instances in the electric light service in this country a similar view, namely, that any one could make joints, and that any kind of joints might be made, was held by those who should be supposed to know to the contrary.

In this city I think it is now fully recognized, by the electric light companies at least, that it pays to employ good jointers in underground work.

Several forms of joints are used on the electric light cables in subways, among them one known as the rubber joint. It is sometimes termed the half marine joint. This joint is made practically as follows: First the lead covering is removed for about three inches from the end of the conductor. About one inch of the insulation is then removed from the ends of the conductor; the ends of the conductor are then "sweated" together, generally a split copper sleeve being placed over the ends. When a T joint is to be made a T sleeve is used. This facilitates the making of the joint by dispensing with filing the ends of the conductor, and then wrapping them with small wire. No acid is used in the making of the joint. Resin is commonly used as a slag. After the wire has been spliced, the insulation is scarfed for about three-quarters of an inch, when a layer of pure rubber strip is wrapped around the wire spirally back and forth about three times, and each time the rubber is brought further up the scarfed insulation. A few layers of white rubber strip is then wound above the pure rubber strip, and after that a layer or two of pink rubber strip. A layer of fibrous rubber tape is then put on over all. Between each layer of rubber strip a small quantity of rubber solution is put on to make the rubber adhesive and practically homogeneous. A lead sleeve is then placed over the joint and wiped on to the lead covering. This joint can be made in about twenty minutes, exclusive of time taken in wiping the lead sleeve. This joint is used altogether on the Bishop and the Safety cables, also occasionally on the Standard and Cobb cables; but as a rule the Cobb people make a special joint somewhat as follows: the ends of the conductors are spliced in the usual way, a hard rubber ferrule having first been placed over one end of the conductor and a brass ferrule over the other conductor above the insulation. A machine like a double vise is then placed over the lead covering of the cable and made fast thereto. A tightening device next draws the ends of the vulcanite together, taking up slack in the cable. The vulcanite sleeve or ferrule is then welded by heat to the vulcanite tube, after which the brass ferrule is drawn over the tube. A mold is then placed around the joint, into which molten lead is poured, thus casting a solid lead sleeve. This is quickly cooled by the application to the mold of cold water. The mold is then removed and the joint is complete. This form of joint has been found satisfactory, I believe, and it is claimed that it can be made in much less time than a half marine joint.

The joint chiefly used on the Standard underground cable is made differently from either of the foregoing. After the conductor has been spliced as usual, and the lead covering has been cut back from the insulation, a few turns of tape is passed around the splice. A leaden sleeve is then put on over this and wiped firmly to the lead cover of the cable. When this has been done a couple of small holes are punctured in the lead sleeve, through which a boiling insulating compound used in the manufacture of the cable is poured, filling up the sleeve completely, after which the holes are closed by solder. These joints have been found to give excellent service on this form of cable. The time taken in making this joint is about thirty minutes.

LEAD-COVERED CABLE.

The cables used in the electric light service in the New York subways are, as I have elsewhere stated, without exception, lead covered. In the case of fibrous insulation, this is essential to exclude moisture, but not in the case of the rubber cables, except as a protection against gas and acids, and, to a certain extent, mechanical injury. The use of this lead covering is not required by the subway rules. In addition to being a protection against the attack of acids and gases, the lead covering is considered a safeguard against accidents to men working in the manholes among live wires. For, in the first place, if a defect should occur in the insulation in the manhole, the presence of a ground furnished by the lead covering would make the defect known at the regular test, which, if the defect were of a serious nature, would insure its being located and eliminated. If the conductor were not lead covered, there is a probability that a defect in the insulation might occur that would not be indicated by the test, but which might expose the conductor and render it impossible for workmen in the manholes to make contact therewith. It would be quite possible for a workman to handle the lead covering of even a defective conductor without injury, since the lead covering is grounded throughout the length of the subway.

It will hardly be credited by some people, but it is a fact, that live electric light wires conveying the alternating high tension arc currents are handled and moved about in the manholes by means of the lead covering without the slightest indication that such wires are alive. In fact, it is quite a common occurrence to start up alternating circuits immediately after a rubber joint has been made in order to save time, and then to have the plumber adjust and wipe the sleeve on the lead cover while the current is in full operation.

Another fact is this, that in the subways no shocks whatever due to induced currents in the lead covering are felt by the workmen in handling the lead-covered cables conveying the alternating current. It is quite conceivable that such shocks might be noticed, as I believe they are, where the cables are suspended from point to point and insulated. In that case, any one handling the lead covering of the conductors would doubtless receive the accumulated induced charge.

It has been stated frequently that such induced currents, where the lead covering of the conductors is insulated, have been known to injure the lead covering and eventually to destroy the insulation. So far as I have been able to ascertain, not in a single instance has such an action taken place in the subways.

As a matter of fact, close personal observation and careful inquiry on all sides have failed to discover thus far any sign of deterioration in the condition of the material of the conduits, the lead covering of the insulation, or of the insulation of the cables in the subways, with the exception of the effect upon the lead covering of the telephone cable in the creosoted wood conduit referred to. I may add that, even in the latter case, personal investigation and inquiry made of workmen have not confirmed the statement that the lead covering has been attacked. At all events, there is no evidence of any such wholesale manufacture of white lead as has been reported from other places where lead-covered cables have been placed in creosoted wood boxes.

INSULATION AND TESTS.

The requirements of the rules of the Subway company as regards insulation are such that none but a first-class insulation can well be employed on the conductors conveying currents of high electromotive force. These rules require an initial insulation resistance of 15 megohms per mile per 100 volts electromotive force employed on the circuit, and a minimum of 5 megohms per mile per 100 volts. The initial test is made when the conductor is first laid in the subway and prior to the turning on of the current. The minimum requirement is allowed after the circuit has been in

[1] Read before the New York Institute of Electrical Engineers.

use. This insulation requirement refers to the conductor proper in the subway, and does not include the lamps, aerial connections or converters. The rule does not apply to conductors conveying currents of less than 100 volts e. m. f. In the case of alternating circuits the uniform electromotive force employed in this city being 1,000 volts, the conductors to be employed in this service are required to show an initial insulation resistance of 150 megohms per mile, and a minimum insulation resistance afterward of at least 50 megohms per mile.

The average e. m. f. of the arc light circuits in the subways is about 2,000 volts, but in some instances it runs up to 3,500 volts. In the latter case the initial insulation resistance required by the rules is 525 megohms per mile; minimum 175 megohms per mile.

It was at first thought by many that it would be impossible to maintain even the minimum insulation resistance required by the rules, and this supposed impossibility was cited by some of the electric light companies as an instance of the impracticability of the proposition that they should utilize the subways. The representative of one such company very naively stated that it would certainly be impossible for his company to maintain this insulation if compelled to go into the subways, as the insulation his company used in its service was "underwriters'." One of the experts of the same company, in his evidence, repeated the very common remark that one megohm, if it could be maintained, would be quite sufficient for practical purposes. I do not think this statement will be seriously contradicted, but the difficulty is to maintain the insulation resistance at one megohm in practice. Experience in the New York subways has shown that it is vastly easier to maintain the insulation resistance at 150 and even 500 megohms per mile than it has been in the past in other cities to maintain them at one megohm per mile. A gentleman, writing of the Chicago underground system not quite two years ago, remarked: "It was found that although the insulation measurement of the lead covered cables in the conduit was very high, considerably above a megohm, a short circuit would form generally within 1,000 feet of the station between the two sides of the circuit."

The explanation for this short-circuiting under such conditions would appear to be very simple—namely, that if the insulation resistance of a conductor is but one megohm per mile, the covering being of the ordinary thickness, it is clear enough that it is decidedly inferior insulation, and if the normal insulation resistance of the conductor is very much higher than one megohm per mile, but the measurement nevertheless shows it to have an insulation resistance of but one megohm, it is or should be sufficient evidence that a fault has developed in the insulation which need surprise no one when it produces a short circuit or burn-out.

As I was in no wise responsible for the promulgation of the subway rule, which places the initial and minimum insulation resistance of the electric light conductors at the figures given, not having been connected with the company in any capacity at the time the rule was authorized, modesty need not restrain me from saying that experience of over a year has amply proven the wisdom of those requirements. For these requirements not only necessitated the use of an insulating material possessing high specific insulation, but also compelled the exercise of the greatest care in the details of placing the conductors in the conduits, in the making of joints, etc.

When it is stated that these conductors are jointed at every manhole, and in many instances at several places between manholes, the need of such carefulness in order to maintain a high insulation will be understood.

If for example, the method of making joints that, it is related, was employed some years ago in Philadelphia—namely, to strip the ends of the lead covering for 2 or 3 inches, and then to place 3 or 4 turns of tape around the ends of the conductor, had been followed in the New York subways, and had been permitted in the absence of the rules referred to, I have no doubt I would have had to report to-night a continued series of failures in the electric light service similar to those so often quoted as having happened in Philadelphia. I am confirmed in this belief by the fact that the first electric light conductors laid in the New York subways were found to possess an insulation resistance of but little over 100,000 ohms. This, notwithstanding that the insulation resistance of the conductors at the factory was over 2,000 megohms per mile. There were about 40 joints in these conductors. Where these had been cut out and new ones made by an expert jointer, the insulation resistance rose to over 1,500 megohms per mile, and a very recent test of the same circuit shows it to still possess virtually the same insulation resistance.

Under the methods once in vogue in other cities in this country with regard to underground work in which no tests for defects were made, excepting for such as would be indicated by an ordinary magneto, the circuit I have referred to would have been put into operation without question, and there is, I think, not much doubt as to what the outcome would have been.

The high tension electric light conductors are tested weekly for insulation resistance. The tests are made by the direct deflection method, a Thomson reflecting galvanometer being used, and as a rule 100 cells chloride of silver battery is employed as a testing battery. The tests are generally made from some room or basement adjacent to the terminals of the conductors in the subway, in order that the subway portion of the circuit may be tested exclusive of aerial portions.

At present the subways do not extend to the electric light stations, although in a very short time they will do so in the case of the Stanton Street United States Illuminating company's station.

When the conductors emerge from the subways they are run through subsidiary iron pipes up the side of a pole. From this pole the testing lead wires are run to the testing room.

The subway conductors are, as a rule, tested exclusive of arc lamps, converter and inside wiring, but frequently also the tests are made inclusive of arc lamps and converters. These latter tests are only accepted when the results fairly indicate that the fall of insulation is due to the lamps or converters. In quite a number of cases the tests with converters included show an insulation resistance up to the requirements.

Tests of circuits are not made inclusive of house wiring, because of the generally low results of trial tests. Some such tests that I have made showed an insulation resistance of the house wiring of less than 1,000 ohms.

The following record of actual tests may be of interest:

Circuit A. Arc.—Initial test 588 megohms per mile. Last test of same circuit 388 megohms. Present length of circuit 9.5 miles.

Circuit B. Alternating.—Initial tests 141 megohms. Last test 1250 megohms. Length 9.6 miles. The first test was made when circuit was much shorter than at present, and doubtless the terminals of conductor were exposed during that test.

Circuit D. Initial test, January 6, 1889, 424 megohms per mile. Subsequent test, January 2, 1890, 484 megohms per mile. Length of circuit, 2 miles.

Circuit E. January 4, 1889, 1750 megohms per mile. Same circuit January 4, 1890, 1516 megohms per mile. Length 1 mile.

Circuit F. July 7, 1889, 264 megohms per mile. January 3, 1890, 343 megohms. Length 6.6 miles.

The readings for these tests are generally taken after 1 or 2 minutes' electrification.

Tests with converters included in some cases show very fair insulation. One circuit with 34 converters included showed 11 megohms insulation resistance. Another with 11 converters included gave a total insulation resistance of 159 megohms. It is not uncommon to get an insulation resistance of from 2 to 5 megohms with 30 and 40 converters in circuit. These tests did not include aerial portions of circuits. It should be said that the insulation of the converters and connections is being constantly improved and in my opinion the time is not remote when the underground circuits will test up to requirements at all times with converters included.

As all of the conductors of the same company do not terminate at any one point, and the instruments have to be moved from place to place, the apparatus used in making the tests is of a portable pattern. The entire outfit can in an emergency be carried by one person, and very readily by two persons.

Contrary to the expectations of some people, the actual making of these electrical tests has not been attended with any serious difficulty. The most troublesome factor has been that due to surface leakage at the battery or other parts of the testing equipment during the very humid weather, which prevailed so continuously last summer and winter.

The time for making these tests is as far as possible chosen to suit the convenience of customers. The majority of the tests are now made in the early mornings. All circuits are tested once a week at least.

About 130 miles of the subway electric light converters referred to are employed as carriers of alternate current for incandescent lighting. About 60 miles as carriers of arc light circuits, and incandescent continuous current. These circuits vary in length from 1 mile to 11 miles, the longest arc light circuit is 10 miles in length, the longest alternating circuit is 11 miles in length. In 10 miles of alternating or arc circuit there are from 450 to 500 joints. The greatest number of converters on one subway circuit is 65. There are 14 arc light circuits and 25 alternating circuits in the subways.

Quite recently an alternating circuit has been installed in the subways which is intended to be the pioneer of numerous such circuits. I may say that it is ultimately intended to operate at least 125 lamps in such circuits.

LIGHTNING ARRESTERS.

In the case of many of the electric light circuits that were first laid in the subways of New York city, lightning arresters were used at street lamps and at the terminals of the cable, and in a number of instances the same apparatus is still used. These "arresters" are those known as the Acheson cable protector, and are intended to protect the cable against disruptive discharges from any source. The principle upon which the device is intended to act is that the disruptive discharges, or what would be the disruptive discharge, will jump the air space between the points of the needles, thus relieving the cable from the strain. The utility of this device for the purpose intended has yet to be demonstrated in this city, inasmuch as the frequency of burn-outs in unprotected cables in the subways has been no greater than in those which are equipped with the protector, the percentage of burn-outs on cables in either case being, as I have before intimated, very low. It is as yet I think, an open question whether the use of this or any equivalent device is warranted. There is no record of any of the cables in the New York subways having received injury from lightning during the past year.

It is commonly supposed that the freedom from burn-outs which the successful electric light cables in the New York subways have enjoyed, as compared with the earlier experience of other cities, is due to an increased thickness of insulation around the conductor. This may be the correct explanation, but the fact is worthy of attention in connection with this subject that certain electrical condensers have for years been placed in positions where they are exposed to the full effect of lightning discharges on telegraph lines, without, in a single instance, having sustained injury therefrom. Similar instruments have also been placed across the poles of 1,000 volts alternating dynamo machines for days without perceptible harmful effect. Since it is difficult to imagine a better opportunity for a disruptive discharge to effect its escape to earth than that presented by the extremely thin tissue paper used in those condensers, the thought is suggested that if this paper can be so constructed as to act as a barrier to the passage of such charges there may be more to be considered in this matter of insulation than the mere question of thickness of the insulating material.

ALLEGED DANGERS OF THE SUBWAYS.

The dangers to be apprehended from the existence of the electrical subways and from the placing of the high tension wires therein, according to those who are perhaps more or less inimical to that action, are varied. In general terms, they say that the dangers which menace the public and employes from the presence of wires overhead will be multiplied manifold when the wires are underground. But when asked to specify those dangers, the reply is limited to the following—namely, first, that the linemen will be killed by coming in contact with live wires in the manholes; second, that high tension currents will leave the subways and enter buildings by way of water and gas pipes, etc., and third, that accidents due to explosions of gas in the subways will be numerous.

As regards accidents to workmen in the manholes due to contact with live wires, no one will say that such occurrences are impossible, but inasmuch as not a single accident of this kind has occurred in New York city, or so far as I can learn elsewhere in electrical subways, it is fair to assume that with the exercise of proper supervision of the wires this is not likely to prove a frequent source of accident. I was present at the inquest of one of the unfortunate linemen who was killed last year in New York city by contact with an overhead wire, when a witness who had just made the statement that he apprehended more accidents from the placing of wires underground than had occurred overhead, was asked if he was aware that there were at the time about 100 miles of electric light wire underground in New York city conveying high tension currents, and that not one accident had thus far occurred in the manholes; to which he replied that this state of things was explainable in his opinion by the fact that the electric light wires underground constituted but one-tenth of the electric wires of the city, and that when all the wires were underground the accidents in the subways would increase in the same proportion—which reply caused the foreman of the jury to remark that the public would probably not complain of an increase of accidents from nought to 10 times nought.

I have already suggested in another place that the fact of the wires being metallically covered may have conduced to the immunity from accidents which the workmen in the manholes have enjoyed. I may interpolate here that it is recognized that the efficiency of the manholes would in many instances be increased if they were larger, and wherever the surrounding condition of the street will permit, it is, I believe, contemplated to enlarge the manholes.

So far as the statement is concerned that danger is to be apprehended by the entrance of powerful currents into buildings by way of water and gas pipes by contact of a grounded conductor in the subways, it would scarcely be worthy of notice before a body of electricians, but for the persistency with which it is said to be urged by men of prominence in the electrical profession. It is conceivable that if a conductor within a building should by accident come into contact with a well-insulated gas pipe also within a building, one might receive a shock by contact with the gas pipe if in some manner he should complete the circuit, but in what manner, in the event of a ground in the subways, any dangerous current can be conveyed to the inside of a building by means of gas and water pipes which have the entire area of the city's foundation as a ground or return circuit, is more difficult to understand.

But whatever may be the dangers, stated and unstated, so freely predicted as liable to occur with the wires underground, it may certainly be said that with the electric wires underground, men will not be injured by falling off poles in the subways. Wires when in the subways during the prevalence of sleet storms, will not fall upon people or horses in the street, nor be torn down by elevated railway trains, street cars, etc.

GAS IN THE SUBWAYS.

In my opinion, the presence of gas is the most serious defect of the electrical subways in cities; of course it is not an inherent defect in the subways, but it is nevertheless a very troublesome one, not only because of the danger of explosions therefrom, but also because of its ill effects upon workmen employed in the subways

As previously remarked, the ducts used in the subways are not only joined together as nearly hermetically as possible, but except in the case of distributing ducts, they are laid in a solid body of cement from manhole to manhole. It is supposed that the gas obtains ingress to the manholes through the place where the iron manhole cover rests upon the masonry of the manhole. But at whatever point the gas enters the subways, its unwelcome presence is acknowledged, and while it is self-evident to any one who will investigate the matter for himself, and is actually admitted by the gas companies that the gas emanates from the gas mains in the streets, nevertheless the subway engineers have been constantly at work devising means to remove the intruder.

To this end various methods for ventilating the subways have been suggested and tried, the most successful of which thus far has been the ventilation of the subways by the use of blowers stationed at intervals along the subways, and arrangements are now in progress to place 15 such blowers in operation to cover the entire subway system.

As the ducts become filled with cables, however, the free passage of air through them is prevented, and in this way the utility of the blowers is diminished. In order to evade this difficulty a 6-inch wrought iron pipe has been laid above the subway ducts in the more recently constructed subways. This large iron pipe has openings at each manhole. The openings are graduated as to their extent, as they recede from the source of the air pressure. The large openings are at the points remote from the blower. It is intended by the use of these large pipes to furnish a counter pressure in the subways somewhat exceeding any tendency of a pressure from the outside, rather than to produce a strong current of air through the ducts, and in this way to prevent the ingress of gas through any crevices that may exist in the subways.

It has been frequently suggested that good results might follow a suction method of ventilation, but experience has shown that this would rather aggravate the evil, as it would

draw into the subway all the accumulated gas in the streets besides inviting a larger leakage from the gas mains.

The only beneficial effect to the subways of this resort to blowers to drive out the gas is that the air dries up the ducts and manholes within quite a distance of the blowers.

The cause of these explosions in the subways has not in every case been definitely located. It is known that they are due primarily to the ignition of an accumulation of illuminating gas mixed with atmospheric air in explosive proportions, but the difficulty has been to ascertain by what means the gas has been ignited. It is on record that these explosions have occurred in sections of the subways in which there were at the time no wires whatever. And in cases where there have been live wires in the vicinity of an explosion, tests made immediately after the event have shown that those wires were in perfect condition as regards insulation. There are but three instances on record in which a defect in an electric light cable has occurred simultaneously with an explosion in the subways, and in one of these cases the defect occurred so nearly incidentally with the explosion, that while it is quite possible that the defect may have caused the explosion, it, the defect, may have been due to mechanical injury due to the explosion.

Among other theories it has been suggested that the gas may be ignited by induced currents, induced in the lead covering of alternating current conductors. This might be the case if, as I have before suggested, the cables were supported from beam to beam, as on a bridge, on insulated stands, and if the lead coverings only approached each other at intervals, but where the lead coverings of the conductors are not only grounded throughout their lengths as in the subways, but are also joined metallically, in fact, are practically one cable in the ducts, it seems unlikely that a quantity of induced electricity sufficient to produce a spark could be accumulated at any one point.

In the case of at least two explosions in New York City the evidence showed that the gas in the subways had been ignited by a lighted lamp or match in the vicinity of some subsidiary duct connecting with the subways. In other instances, by a match or lighted cigar thrown in a manhole. It is known that in Chicago an explosion was caused in the subways by a live coal from a passing fire engine, falling upon the cover of a manhole.

With but one or two exceptions the explosions have not injured the cables in the subways; which is probably due to the small and round surface which the cables present.

It has frequently been suggested that if solid ducts were employed instead of tubular ducts, these explosions would be avoided. While this would be, if correct, a strong argument in favor of solid conduits—that is, ducts in which the conductors are not removable—notwithstanding the generally admitted fact that such ducts are not practicable for subway work on a large scale, experience has demonstrated that explosions have occurred repeatedly in manholes and in small junction boxes of subway systems in which there were no hollow ducts.

I may add that pending the installation of blowers in certain of the subways men are employed day and night opening manholes to permit escape of gas.

I had intended to comment briefly on the comparative expense of maintenance and reliability of underground wires in cities as compared with overhead wires, but as my paper has far exceeded the limits which I had placed upon it, I shall leave that and other features in abeyance for the present. Perhaps something bearing on those points may be brought out in the discussion.

The following are some of the rules of the subways of New York City, which have been promulgated as precautionary measures, or as a result of actual experience:

No bare ends or bare portions of conductors, whether in or out of service, are permitted in the manholes. Every conductor in the manhole is treated as though it were operative.

No joints except such as are protected by a metallic covering are permitted in the manholes.

No lights are allowed in manholes.

All conductors in manholes are required to be arranged symmetrically around the walls and to be plainly tagged with the designating mark of circuit and the name of the owner.

No switch boxes are allowed in the manholes. The reason for this is that in the first place a switch box for each company would take up too much of the limited room; and secondly, in the case of electric light circuits it is feared that attempts to change live circuits might produce dangerous sparks in the manholes.

In conclusion, I think it may be said that the experience derived from the practical operation of the electrical subways of New York City has either made apparent or confirmed, among other things, the following:

That it is possible to successfully operate all classes of electric conductors underground in cities.

That, at least for conductors conveying high tension currents underground it is advisable to set the standard of insulation high.

That regular insulation tests of the conductors are very valuable.

That liberal thickness of insulation is desirable for high tension currents.

That it is inadvisable to place underground new types of cable or insulation until they have been subjected to tests and conditions analogous to those to which they will be subjected underground.

That for electric lighting conductors—especially distributing mains—many conductors under one cover are not advisable, owing chiefly to the difficulty in making joints in such cables.

That all sharp edges in ducts should be avoided.

That until the gaslight companies are required, like the electric light companies, to maintain their mains in a fairly sound condition, underground, a means of ventilating the subways should be provided simultaneously with the construction of the subways.

And lastly, that while other features may be accessories thereto, the employment of smooth, strong conduits—accessible ducts for distribution of the current—first-class insulation—constant expert attention to details and thorough organization in every department, are essential to the production of a successful electrical underground system.

Proposed Government Telegraph System.

Representative Wade of Missouri, introduced a bill in congress Tuesday, February 18, providing for the establishment of a government postal telegraph system. The bill creates a bureau under the control of a fourth assistant postmaster-general, with a salary equal to that of the other assistants postmaster-general. This officer shall cause to be constructed through the states and territories a trunk line of postal telegraph, to reach and connect all cities and towns that now have telegraphic communication. The postal telegraph shall be constructed and kept in repair under the direction of the secretary of war, through the corps of engineers, and the postmaster-general is authorized to employ all persons necessary to conduct the business of the proposed system. The rate for transmitting messages shall be, for 500 miles or less, 10 cents for twenty words; from 500 to 1,000 miles, one cent a word, and a corresponding decrease for greater distances. Press dispatches are to be taken 1,000 miles or less at one-third of a cent a word, and greater distances at proportionate rates. All persons shall have the right to the use of the telegraph lines for the purpose of corresponding at the rates fixed by the postmaster-general. There is nothing in the act to prohibit individuals or corporations from carrying on the business of operating telegraph lines. Eight million dollars is appropriated for the purposes of the bill.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 8.—The subject which is of the keenest interest to the people of this city has had a pretty thorough discussion this week. The injunction obtained from Judge Patterson to restrain the mayor and the Board of Electrical Control from awarding the subway contract to the Standard Subway company was argued before Judge Andrews on the 5th and 6th insts. The motions of the petitioning companies to make permanent the injunction were presented by Elihu Root and De Lancey Nicoll. These petitioners include the Mount Morris Electric Light company, the Manhattan Electric Light company, the East River Electric Light company, the Northern New York Electric Light company and George B. Armstrong, taxpayer. Edward Lauterbach and William N. Cohen appeared for the Consolidated Telegraph & Subway company which has hitherto been authorized to build the subways. W. Bourke Cockran and Paul D. Cravath appeared for the United States Illuminating company and the Brush Electric Light company and David J. Dean for the mayor and the Board of Electrical Control. Wheeler H. Peckham, counsel for the Standard Electric Subway company, also appeared in behalf of the mayor and the Board of Electrical Control. The real point at issue is whether the mayor and Board of Electrical Control have the legal right to enter into a contract with the Standard company for the construction of subways for electric light and power wires. Judge Andrews has reserved decision and announced that it would be ten days before it would be presented. The people of New York want electric light at the earliest possible moment and now that no overhead wires can be used, the subways cannot be built too rapidly.

The senate committee on general laws, which is intrusted with an investigation of the present regulations governing the use of electricity, continued its sessions in this city during the week, but is not a bit wiser than when the examination was commenced. The absurdity of these so-called investigations is apparent to all who know the members of the committees. Truly it is an edifying spectacle to see the legislature of this great state represented in such an investigation by a lot of farmers, who have no more idea of what the witnesses are talking about than they had of electric lights until they were sent to Albany to represent their rural constituency. During the first few sittings of this board of inquiry the members endeavored to familiarize themselves with electrical terms, but at the end of the second week they despaired of mastering their tasks and discontinued their elementary lessons. Meanwhile they assume an air of profound wisdom, keep their mouths shut except when they cannot restrain an inclination to yawn, and with the aid of an expert, they will make a report to the legislature of their deliberations—all of which will cost the State of New York many thousands of dollars, and cannot from the nature of the committee, result in any benefit to the people. It is a howling farce, and the sooner it is discontinued the better it will be for the dignity of the senate and the purses of the tax payers.

Chief Justice Durfee of the Supreme court of Rhode Island has just handed down an interesting decision in an injunction action in which Philip S. Taggert and other property owners along the line of the Newport Electric Street Railway company's proposed system, endeavored to restrain the construction of an overhead line. The judge holds that the poles do not encumber the streets, that they facilitate travel, and are a great benefit to the community. The decision is a decided victory for electric railways.

The Philadelphia syndicate which purchased the Newark street railroads is also reported to have secured the control of the Newark and Elizabeth road. This line runs from Elizabethport through Elizabeth to Lyons Farms, and thence another line of a different gauge runs through Waverly to the Paterson depot in Newark. It is the intention of this syndicate to equip all its lines with the electric system at an early date.

The formal opening of the Progress club, corner of Fifth avenue and Sixty-third street, will be of a brilliant character. Gov. Hill and Mayor Grant will be present, and give a distinguished tone to this new departure uptown. The club house is magnificently fitted with all the latest electrical devices for lighting, and presents a magnificent spectacle. The Tucker Electrical Construction company have had the installing of a Mather plant in charge, and every detail has been carefully looked after.

Quite a number of New York experts attended the hearing before the senate committee of the Ohio legislature on the regulation of high tension currents. Harold P. Brown had arranged for killing a couple of animals at the Edison station for the edification of the committeemen. Mr. Brown showed how he intended to execute murderers in New York state, according to the laws of that commonwealth, by "shocking" a horse to death. A second attempt on a calf proved unavailing. This, though unannounced, was undoubtedly an illustration of his manner of bungling cases. In view of this fact the necessity of adopting the amendment to the law providing for the admission of newspaper men at electrical executions and the publication of the details of the same, should at once present itself to every legislator in New York. R. W. Pope and William Maver, Jr., presented arguments against the bill and several Ohio companies were represented by Columbus attorneys. The committee has not yet completed its labor.

Commissioner Gilroy has sent to the Board of Estimates a list of the streets which he deems it necessary to repair at once. He accompanied it with a letter in which he recounts some of the difficulties of thoroughly improving the streets. Among these difficulties are the excavations frequently made by private corporations and individuals, the building of electric sub-ways, and the center-bearing rails used on the surface railroads. W. H. T.

Boston, Mass.

BOSTON, March 8.—The most severe test which the electric cars have had since their inauguration in this city was experienced last Monday after a snowstorm that left fully eight inches of snow on the level and banks many times that depth on all the streets. The way in which the cars overcame the obstructions from snow and proved themselves worthy of all the confidence that the railway company has put in them, is well put in the Boston *Herald* of the day after the storm: "The storm gave the first real test of the power of electricity to contend with the snow, and the result has been a most gratifying success to its most sanguine friends, and at the same time a sad surprise to those who have been predicting a sure defeat when a snowstorm came. Although all the horse cars have had four horses attached to them, they have had a hard time laboring through the drifts and heavy snow, and have crawled along at a snail's pace, even where the tracks have been cleared by the snow plows. While the poor horses have tugged and strained to pull the heavily laden cars the electric cars have glided along with scarcely a noticeable diminution of speed, and even where the snow on the tracks has been up even with the pans under the motors, the cars have gone along as though such a thing as snow was unknown, the little rail plows cleaning the way in front of the wheels as readily and cleanly as could be desired. The electric cars were found much more reliable than the horse cars, and where the electrics were not detained by horse cars on the same track, they were on time every time."

The snow sweepers did good work in clearing the tracks, but it was found that the necessity of running them at the time of day when the cars were carrying their heaviest loads—between 5 and 7 in the evening—called for a greater expenditure of power than the company has at command. The power now available is, however, not far from 2,000 horse power, produced by eight Edison dynamos of 80,000 watts' capacity each, and fifteen Thomson-Houston generators of 60,000 watts' capacity each. Additional power will be furnished after this week by the Cambridge Electric Light company to relieve the load of the two West End power stations whenever such relief may be necessary. President Whitney very sensibly says: "As four horses are required to move a car in a snowstorm, instead of two as ordinarily, and as an additional number of horses are required for the snow plows and other appliances for clearing the tracks, just so on the electric lines, a large reserve of power will be required for such emergencies."

The Thomson Electric Welding company has just received a highly gratifying report from the naval board, appointed some weeks ago by the secretary of the navy to examine and report upon the advisability of adopting the Thomson welding machines for use in the government navy yards and on board the government cruisers. The report recommends the adoption of the welders for these purposes and says: "It is the unanimous opinion of this board that such a system as that which has been investigated by us,

becomes not only desirable, but a means to economy of expense, time and labor, and would add to the efficiency of the vessel under any condition of service." Another report which the company is mailing to its stockholders along with the report of the naval board, has been received from Prof. Alex. B. W. Kennedy of London, Eng., who was sent to Boston by the English welding syndicate to investigate the merits of the Thomson welding apparatus and report upon the progress and development made in this art up to the present time. Prof. Kennedy says that "the Thomson electric welding process has already in America been fairly carried beyond the experimental stage, and has achieved sufficient success in regular commercial work of somewhat varied kinds to warrant the belief that its industrial future is one of the greatest practical importance."

The shares of the Edison Phonograph Toy company were listed on the Boston Stock exchange yesterday. The capital stock is $1,000,000, in $10 shares.

The Boston Electric club will hold its next weekly meeting around the table at Young's Hotel next Monday night. The dinner is to be followed by a discussion upon the "Transmission of Energy," in which Prof. Elihu Thomson is to take part.

At the State House, on Beacon Hill, considerable interest is manifested this week in the hearing before the committee on manufactures of several petitions for legislation authorizing cities and towns in the commonwealth to manufacture gas and electricity. The Massachusetts Electric Lighting association was represented as a remonstrant by E. W. Burdett. The hearing will be continued next week.

The board of aldermen has passed an ordinance requiring the West End Street Railway company to equip all of its electric cars with sand boxes, so that the driver may at will use sand upon the rails by pressing a lever with his foot.

Although Justice Field, of the Supreme court, has decided against the Suburban Light & Power company in its suit against the Boston board of aldermen, the company continues to make preparations to carry out its contract with the city, hoping to secure a favorable decision when the case comes before the full bench on the appeal. Last night the Suburban company gave a public exhibition of the workings of the new Westinghouse arc light system at the new plant of the company on Norfolk avenue, in this city. Nearly fifty lights were burning, twelve of them in neighboring stores and the others in the station. The test was a perfect success. The plant at present consists of two sixty-five arc light machines and one 750 light incandescent dynamo. O. H. M.

Cornell Notes.

ITHACA, N. Y., March 8.—Four Edison dynamos have been obtained for experimental work in Sibley College. The Westinghouse Electric company is building in its shops a set of small power alternators for Sibley College to be used in experiments in connection with thesis work in the university. A number of motors and dynamos of other makes have been contributed or ordered. Prof. Thomson writes the director, Dr. Thurston, that the Thomson-Houston Electric company will soon send several valuable machines to the university.

The schedule for the annual inspection tours of 1890 has just been issued. Professors Ryan, Nichols, Smith and Canaga will have charge of the different tours. There are to be four sections, substantially as follows: One going west to Cleveland, Pitlsburg, Buffalo, Rochester and Lockport, visiting all the prominent electrical manufacturing establishments and lighting stations; another going east to Boston, Lynn, Manchester, Ansonia and New York and vicinity, a third by way of Scranton to New York, Brooklyn, Jersey City and Orange; and the fourth to Philadelphia, Washington and Baltimore. Among the prominent electrical establishments and corporations visited by the students on the eastern trip are the Boston West End electric railway, Massachusetts Institute of Technology, Harvard College, Thomson-Houston electric works, Brown & Sharpe's works, American Electrical works and the various lighting stations of New England, Edison's laboratory, Weston's laboratory, United States Electric company's factory, Scranton's electric railway and lighting equipment, the Edison plant in the Broadway theater, and other places of interest to electricians. On the Western and Southern trips the students will visit the works of the Brush Electric company, Swan Incandescent Lamp Manufacturing company, Ball Engine company, Cowles Electric Smelting company, Baldwin Locomotive Works, Bement & Miles, and William Sellers & company. The inspection tours for this year will probably be the most interesting and profitable ever taken by Cornell students, as Dr. Thurston has spared no pains in preparing for them.

Prof. Alex. G. Bell delivered a lecture before the electrical engineers and the other students of the university on Friday evening, February 21. He spoke in Barnes Hall on account of lack of accommodations in the physical lecture room, which is generally used for such purposes. He spoke on "Radiometry," a subject of especial interest, and one which has been investigated mainly by Prof. Bell.

Five of the senior mechanical engineers and two of the senior electrical engineers have already accepted positions with Westinghouse, Church, Kerr & company; and will enter upon their work at the close of the college year.

H. H. Westinghouse, general manager of the Westinghouse Air Brake company, and a former Cornell student, informs Dr. Thurston that a complete set of machinery, consisting of air pump, pump governor, and attachments, will soon be forwarded to the Sibley laboratory.

Hon. J. F. Gluck, '74, is interested in a company that proposes to utilize the power of Niagara Falls.

In a recent issue of the *Electric News* appears a likeness and short account of the life of W. A. Anthony, a former professor of physics at Cornell.

An interesting experiment is being made in the greenhouse near Prof. Bailey's residence to determine the effect of electric light on growing plants. A small dynamo is used to supply the current for an arc lamp. Two sets of plants which are as nearly alike as possible at the beginning of the experiment are kept under exactly the same conditions during the day, but at night, one set is exposed to the light rays of the arc lamp. P.

THE ELECTRIC LIGHT.

Decatur, Tex., will introduce electric lights for street illumination.

An electric light plant for illuminating the streets of Pallous, Wash., has been purchased. Commercial lighting will also be done.

The Berkeley, Cal., Development company has been organized with a capital of $200,000. It will establish an electric light plant.

The directors of the Westinghouse Electric company have elected P. F. Kobbe treasurer, and W. L. McCallagh assistant treasurer, to fill the vacancies caused by the resignation of John Caldwell and A. T. Rowand.

During the recent floods in Oregon the works of the Willamette Falls Electric Light company at Oregon City could not be reached on account of the high water. Electric lights in Portland were temporarily cut off.

The Heisler Electric Light company of St. Louis reports recent contracts from the following companies for long distance incandescent electric lighting apparatus: Staten Island Light, Heat & Power company, Port Richmond, Staten Island, New Jersey; Johntown & Gloversville Gas Light company, Johnstown, New York; Germantown Electric Light and Power company, Germantown, Pa.; the Electric Light company, Milledgeville, Georgia.; Messrs. Rheubottom & Bond, Union City, Michigan; Pierre Electric Light & Power company, Pierre, South Dakota.

President Flad, of the Board of Public Improvements, St. Louis, says that the action of the council in the Sutter matter will not materially change the attitude of the board toward Mr. Sutter. The board will still insist upon the use of the best of the two lamps now under consideration, and will hold Mr. Sutter to his contract. No date for the final test has yet been made and the board's trip to Cincinnati has been practically abandoned. The extension of time granted by the council, it is said, has enabled Mr. Sutter to raise in New York City funds which have been withheld during the pendency of the threatened immense liability of the Municipal Electric Lighting company.

THE ELECTRIC MOTOR.

The question of electric railways is attracting considerable attention in Buffalo, and the relative merits of the overhead and storage battery systems have been earnestly discussed in that city. A valuable paper on the Sprague system was read before the Buffalo Electrical society last week by E. E. Higgins.

An interesting application of electricity to the dairy industry has been made in Italy. The Count of Assata, whose buildings are fitted up with electric light, has installed a 12 horse-power motor in his dairy. This machine drives a Danish separator and a Danish churn of considerable size, at the rate of 120 to 160 revolutions per minute, the butter being brought in from 30 to 35 minutes. A pump is also worked in the dairy, and various other operations are conducted by electricity.

The Tacoma, Wash., *Sunday Times* speaks of the newly constructed electric street railway in that city in the following complimentary strain: "There is probably not an electric street car system in America where the difficulties to be overcome in the way of street grades and curves with short radii are so numerous as in this city, or where the extremes between no load and full load on the circuits fluctuate so rapidly. But these conditions have been fully met by the construction company, and Tacoma can pride herself on one of the best electric street car systems in the country."

It is reported that Henry Villard is organizing a big stock company in New York for the purpose of erecting an electrical manufacturing house at Meeker Island, near Minneapolis. It is proposed to manufacture electric motors for street cars, and also to operate all kinds of machinery. Other electrical devices will be manufactured. A Minneapolis correspondent writes: "The erection of these works is the outcome of the Villard-Meeker dam scheme. Three sets of dams are to be erected in the two miles below Meeker Island. Electricians say that if the Villard-Meeker dam scheme is carried out—as it undoubtedly will be—local manufacturers can then be supplied with power at a price equivalent to the $2 per ton now paid by the Eastern manufacturers for coal. It is not the citizens of St. Paul and Minneapolis alone that are likely to be benefited by Villard's great scheme when consummated. The demand which will be created for iron and steel in the equipment of steel railroads, the making of electric motors and the machinery required for the immense number of factories to be secured, will materially aid the settlement of Northern Minnesota. The iron ore in the counties of St. Louis, Lake, Cass and Itaska is almost inexhaustible."

THE TELEGRAPH.

An incidental benefit accruing from the erection of the Forth bridge is that telegraph and other electric wires crossing to the north of Scotland, which have heretofore been laid in cables under the Forth, can now be run along the bridge. This will avoid the expense caused by damage from anchors. When the communication by the viaduct has been properly established it is proposed to remove most of the cables in the Forth.

Dr. Norvin Green, president of the Western Union Telegraph company, does not believe in the practicability of the scheme proposed by the postmaster-general, and when called before the congressional committee on postal telegraph, stated his views in an emphatic manner. Dr. Green believed that the United States government had no business with the management of the telegraph; it could not manage it as cheaply, it could not do it better, and none of the senders of telegrams had asked it. It was prepared to make a rate of one-half of the cost of sending messages and the deficiency would have to be made up by the 57,000,000 people who did not use the telegraph. The receipts of the New York office of the Western Union included $700,000 annually from pool rooms and sporting places. A large class of telegraph users were stock brokers and speculators. Were those the people who were to be protected? Dr. Green contended that if the government wanted to go into the telegraph business it should buy the lines outright. It should not fix losing sales for existing companies. The present movement was an entering wedge to break down the present companies and establish a complete government telegraph, and against that he protested. He contended that it would require 21,875 miles of wire to supply a single connection to 447 places comprised within the postmaster-general's plan, and to do business practically would require at least 100,000 miles of wire. At the press contracts the rental of this wire would be $3,600,000. Whoever undertook to do the telegraph business over this system would do it at a loss.

THE TELEPHONE.

The Dade Telephone company has been incorporated at Rome, Ga., with a capital stock of $25,000.

The Pacific Telephone & Telegraph company has been granted a franchise by the supervisors of San Francisco to construct conduits for burying electric wires.

Business Mention.

The new shops of the Sioux City engine works will have a yearly capacity of 100 engines of 100 horse-power each.

C. A. Daigh, who has been for some time associate manager of the Northwest Electric Construction company, has taken a position with the Westinghouse Electric company.

The phenomenal success which has attended the introduction of the Burnley battery is the best evidence of the merits of the article. J. H. Bunnell & Co., New York, who introduced it to the American trade, announce that they have been far more successful than they anticipated.

The Electrical Construction company of Chicago has just finished installing a plant of 700 lights at the Madison opera house, and a 200 number return call and fire alarm annunciator at the Julian house, Dubuque, Ia. The same company is overhauling the electrical equipment of Clem Studebaker's house at South Bend, Ind.

The multiplicity of overhead electric wires in large cities has made it necessary for electric lighting and power companies to provide safety devices against the possibility of accidents which might endanger life and property. One of the latest devices placed on the market is the improved form of Young's safety cut-out. The instrument operates automatically, and when placed in circuit renders the wire harmless, it is claimed, should a break occur. The Knapp Electrical works, of Chicago, are putting the device upon the market in the West.

Mr. Whittingham, the inventor of the automatic switch for electric motors, says he is meeting with splendid success, and that in every instance the switch has given perfect satisfaction. A Boston man reports that by the use of this switch he saved enough in electric current to more than pay for the switch in two months by actual rebate from an Edison local company which furnishes the current. The Sprague Electric Railway & Motor company have adopted this switch for motors, having made a contract for the same. The Chilian government is about to adopt this switch in all government plants.

Shay, Stephens & Co. of Chicago have just brought out a new style of insulated holder which they call No. 35 glass knob. It is designed to take the place of the porcelain knobs now so largely in use in all kinds of electric light construction, and as it is a perfect insulator sold at a price only slightly above that of porcelain, it is certain to receive a very large sale. Although this specialty has been

on sale but a few days the firm has already made a sale of 100,000 to one supply house alone. The firm also reports large sales of their different styles of insulators and a greatly increased demand for all kinds of glass goods manufactured by them.

The Detroit, Mich., Electrical company has increased its capital stock to $250,000 and absorbed the National Traction company. Many improvements are contemplated and additional room will be secured to accommodate the growing demands of the business. The officers of the consolidated company are: Hugh McMillan, president; W. A. Jackson, vice-president; W. H. Wells, secretary, and John G. Rumney, treasurer and manager. These officers and Levi Barbour, Cornelius Corbett, C. E. Warner, Frank E. Snow and Fremont Woodruff, comprise the board of directors. The company is now equipping an electric street railway at Saginaw, and making experiments with a view to supplying motors for the cars of the Detroit City Railway company.

E. Baggot of Chicago has found it necessary on account of his growing business to remove his headquarters from Fifth avenue and Madison street to 169 and 171 Adams street, where he has ample room for displaying his large and well-selected stock of electroliers, combination electric and gas fixtures, incandescent shades and globes of every description. Special designs are furnished when desired, in fact, a specialty is made of elaborate fixtures. The business of this house, which was established in 1861, has grown steadily and since the introduction of electric lighting the addition of a new department was necessary. Mr. Baggot realized the importance of this branch and gave it special attention, and to-day it is one of the best departments in his business. A full line of his specialties is also carried at his branch store, 2134 Michigan avenue.

According to the *News Bureau*, of Boston, the forthcoming report of the Thomson-Houston Electric company will show net earnings for the year of above $2,000,000. Half of this will be paid in dividends and the remainder held as a surplus. The same authority says: The company at present is earning about $15 per share upon its common stock, or at the rate of 60 per cent., the par value of the shares now selling at $51, being $25. The authorized common capital of the company is $10 000,000, of which $4,500,000 have been issued, and $5,500,000 are still in the treasury of the company. The authorized amount of the preferred stock is $5,000,000, of which $1,000,000 was issued in July of last year. Recently $3 000,000 were placed at the disposal of the directors by vote of the stockholders. A portion of this stock has just been offered to the stockholders at $25.25 (par $25). While it was not expected that subscriptions for more than $1,000,000 would be received, at the time the subscription closed they were considerably in excess of $1,500,000. The proceeds of the remaining $1,500,000 will not be required until later in the year. Negotiations for placing this at a considerably higher price are in progress. The annual business of the Thomson-Houston company is now in excess of $10,000,000. The net income per month amounts to $250,000, besides which there accumulates about $50,000 per month of undivided profits from this company's ownership in other companies. The company employs 2,500 hands at its factory in Lynn, and a force of 150 at its Boston office. The Lynn pay-roll amounts to $27,000 per week.

Electrical Patents.

Issued March 4, 1890.

422,419. Armature. Charles D. Jenney, Indianapolis.

422,438. Automatic Switch for Regulating the Power of Electric Batteries. George B. Pennock, Brooklyn, N. Y.

422,445. Supporting Frame for Electric Railway Motors. Edward D. Priest, Lynn, Mass.

422,446. Arc Lamp. George C. Pyle, Indianapolis, Ind.

The invention, while it relates to electric arc lamps generally, is particularly designed for use in connection with those employed with locomotive electric head lights.

422,456. Carbon for Electric Lamps. Walter F. Smith, Philadelphia, Pa.

One of the two claims are given:

"2. A compound filament or pencil for an electric lamp or light having a dried core of fibrous material saturated with zirconium, and a moulded carbonized material thereon.

422,457. Treatment for Storage Battery Plates. Chas. Sorley, New York, N. Y.

422,504. Secondary Battery. Stanley C. C. Currie, Philadelphia, Pa.

422,505. Secondary Battery. Stanley C. C. Currie, Philadelphia, Pa.

The invention consists in a supporting frame for a battery plate or element, provided with a receptacle having vertically-inclined walls lined with a conducting material, and said receptacle adapted to receive and firmly hold the plate or element.

422,511. Dynamo Electric Machine. Rudolph Eickemeyer, Yonkers, N. Y.

The invention relates to multipolar dynamo-electric machines and consists in the combination of a shell or casing having four or more interior pole-faces and longitudinal recesses alternating with said faces, an armature within said shell, and exciting coils or helices occupying said recesses, developing alternate polariy at said faces, directly polarizing the armature, and developing opposite each of said pole-faces an opposite polarity in the armature, and having ends which overlie and magnetize segmental portions of the ends of said armature.

422,512. Electro Magnet. Rudolph Eickemeyer, Yonkers, N. Y.

The first claim reads:

"1. The combination of a chambered shell composed of magnetic metal affording interior pole-faces, an exciting-helix within said shell for developing opposite polarity at said faces and a vibrative armature located between said faces and completing a magnetic circuit which traverses the wall of said shell from one end to the other, and thence internally through the armature to the opposite end of said shell."

422,524. Automatic Circuit-Breaker. Marion C. Happoldt, Providence, R. I.

422,533. Secondary Battery Plate. William P. Kookogey, Brooklyn, N. Y.

The invention consists of a pocket or envelope of sheet-lead perforated to allow of circulation, having its edges closed by folding the edges of one side or sheet of the plate, over the edges of the other side or sheet, and containing active material or material to become active.

422,534. Galvanic Battery. Jacob H. Linville, Philadelphia, Pa.

422,550. Compound Insulating Layer for Electric Coils. Elihu Thomson, Lynn, Mass.

Claims one and five follow:

"1. The combination, with electric coils and the core or support upon which they are wound, of an interposed compound layer of insulating material comprising a layer or base of a fibrous insulating material, and an external layer of a hard non-porous material fastened upon the first.

"5. A compound layer of insulating material consisting of a base of asbestos, a protective and fastening cover of a stronger material, a superposed layer of mica, and an external protective insulating-cover over the mica."

422,556. Electric Motor. Henry E. Walter, Schenectady, N. Y.

The invention relates to electro-dynamic motors which are arranged to be controlled from a distant point, as from a central generating station, and the object is to provide simple and effective means for starting such motors, so that the current shall not pass through the armature coils until the field magnet is charged, whereby injury to the armature or excessive sparking from the passage of current when the field is not energized is avoided. This is accomplished by making use of a switch for the armature circuit whose operation is controlled by a magnet energized by the current, such switch being constructed or provided with means for retarding its movement, so that it will not act to close the armature circuit until the field magnet is sufficiently charged. It is preferred to make use of the attraction of the field magnet itself for operating the switch.

422,577. Apparatus for Speaking Telephones. Thomas A. Edison, Menlo Park, N. J. and Ezra T. Gilliland, Boston, Mass.

The single magnets, or those which it is desired to have always in circuit are provided with a body of non-magnetic conducting material which will absorb the inductive force of the magnets and prevent wholly or to a practical extent the injurious effects upon the speaking currents.

422,578. Telephone Repeater. Thomas A. Edison, Menlo Park, N. J.

The object of the invention is to provide simple and efficient means whereby electric telephone undulations may be relayed from either of two line circuits to the other without the use of switches for changing the line and local circuits in the relay apparatus, and with the result of clear and loud articulation in the receivers of the connected lines.

422,579 Telephone Repeater. Thomas A. Edison, Menlo Park, N. J.

The last claim is given:

"16. In a telephone repeater, the combination, with repeating-instruments, of a centrally-located switching battery, a two-part switch operated by such battery from either line independent of differences in resistance of such lines, and normally-closed keys for operating such switch."

422,592. Reflector for Ineandescent Lamps. Frank Holman, Brooklyn, N. Y.

422,604. Printing Telegraph Receiver. Henry Mahnken, New York, N. Y.

422,614. Type Writing Machine for the Blind. Edward J. Nolan, Chicago, Ill.

422,634. Incandescent Lamp Socket. Frederick C. Rockwell, Hartford, Conn.

422,645. Electric Railway. Sidney H. Short, Cleveland, Ohio.

The invention relates to an improvement in electric railways, the object being to provide means for automatically switching out of operation a section of the conductors which might be accidentally or maliciously short circuited, and thus insure the operation of the remaining portion of the road.

Claim two follows:

"The combination, with a dynamo electric machine and a feeding conductor connected therewith, of a sectional trolley-line, conductors connecting the feeder and the insulated sections of the trolley line, a guard line located adjacent to the trolley line, and safety fuses included in the conductors between the feeder and trolley line sections,"

422,651. Insulator. George E. Stanley. Whitman, Mass..

422,654. Electric Time Alarm and Annunciator. Nathan H. Suren, Fort Worth, Texas.

422,672. Galvanometer. John Waring, Manchester, Conn.

The invention consists in an electro-magnet having a circular core and terminal poles which are one above the other, and a flat and tapering armature which is counterbalanced and mounted upon a non-magnetic pivoted arm and is adapted to swing horizontally between said poles, in combination with a retractile spring, a pointer, and a graduated scale.

422,681. Armature for Electric Machines. John C Wray, Peoria, Ill.

422,705. Switch. Adolph Berrenberg, Somerville, and Jacob Umbehend, Cambridge, Mass.

422,722. Automatic Telephone Call. Henry L. Carpenter, Minneapolis, Minn.

Claim 1 is as follows: "In a telephone-call, the combination, with a switch-board having a series of openings and a series of circuit wires, of a hollow plug adapted to connect any one of said wires with the main circuit-wire and containing separable circuit-terminals, a plug adapted to be inserted in said hollow plug and disconnect said terminals, and a constantly-running mechanism provided with circuit-closers arranged to close the circuits through the wires of the switch-board."

422,730. Method of Electric Welding. Charles L. Coffin, Detroit, Mich.

422,732. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

422,746. Electrical Induction Apparatus or Transformer. Michael von Dolivo-Dobrowolsky, Berlin, Germany.

The invention may be described as follows: A plurality of pairs of coils, each pair consisting of a primary and a secondary coil, are placed upon as many cores of iron, forming three or more closed or nearly closed magnetic systems, and preferably arranged in a circle, and the primary coils are connected to a dynamo-electric machine which produces a number of alternating currents whose phases are shifted in respect to each other by a fraction of a phase, so that the maximum impulsions acting in the individual coils succeed each other, and which currents on leaving the dynamo unite to form a single current or groups of currents.

422,755. Electromotor Engine. Sebastian Z. de Ferranti, Hampstead, County of Middlesex, England.

422,765. Telephone Switch System. Claude C. Gould, Batavia, N. Y.

The object of the invention is to provide a simple switch system whereby connections between the subscribers can be made.

422,773. Electro Magnetic Annunciator. Cornelius J. Hamilton, Philadelphia, Pa.

422,803. Low Water Alarm for Steam Boilers. Edward E. Kildoyle, Yokohama, Japan.

422,855. Pulsating Electric Generator. Charles J. Van Depoele, Lynn, Mass.

The invention is embodied in a dynamo electric machine having an armature of any desired type and having a commutator for straightening the currents therein, stationary commutator brushes upon the normal line of commutation and in electric connection with the exterior working circuit, and an additional traveling commutator brush or brushes in circuit with the return terminal or terminals of the working circuit and arranged to be moved around the commutator with a degree of rapidity corresponding to the number of current waves required to be delivered to the working circuit, which may vary from several hundred per minute down to zero.

The fourth and last claims are:

"4. An electric generator having a sectional armature and commutator, and a set of stationary brushes therefor, and an additional brush or brushes constantly moving upon said commutator to raise and lower the potential in the working-circuits of the machine.

"19. The combination, with a source of pulsating or rising and falling currents of relatively high potential, of an electro-magnetic reciprocating engine having a motor coil or coils, and a magnetic piston moved within the coil or coils in synchronism with the rise and fall of energy therein, and tension-reducing devices in circuit with the said motor-coils and the supply circuit."

422,856. Pulsatory-Current Motor. Charles J. Van Depoele, Lynn, Mass.

422,857. Alternate-Current Pulsating System. Charles J. Van Depoele, Lynn, Mass.

422,858. Converting Continuous into Pulsating Electric Currents. Charles J. Van Depoele, Lynn, Mass.

422,859. Pulsating-Current System. Charles J. Van Depoele, Lynn, Mass.

422,860. Multiple-Current Pulsating-Generator. Charles J. Van Depoele, Lynn, Mass.

422,862. Regulating Electric Motors. George A. Washburn, Cleveland, Ohio.

The first claim is appended:

"In an electric motor, a field-magnet constructed to operate with an armature having the form of a frustrum of a cone and an armature movable longitudinally in the field, in combination with a governor controlling the position of the armature, and an adjustable stop to limit the longitudinal movement of the armature, substantially as set forth."

422,863. Armature for Dynamos, etc. George A. Washburn, Cleveland, Ohio.

422,885. Inductorium. Adrian H. Hoyt, Manchester, N. H.

422,895. Manufacture of Carbons for Electric Lamps. Walter F. Smith, Philadelphia, Pa.

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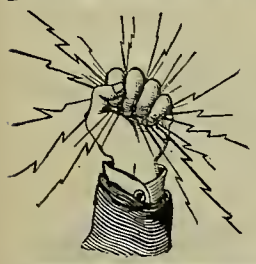

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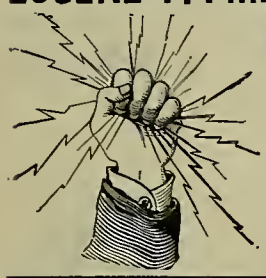

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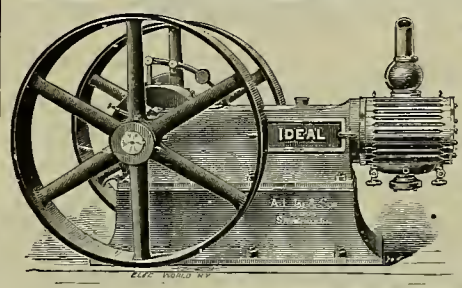

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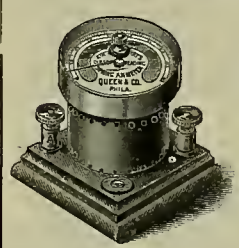

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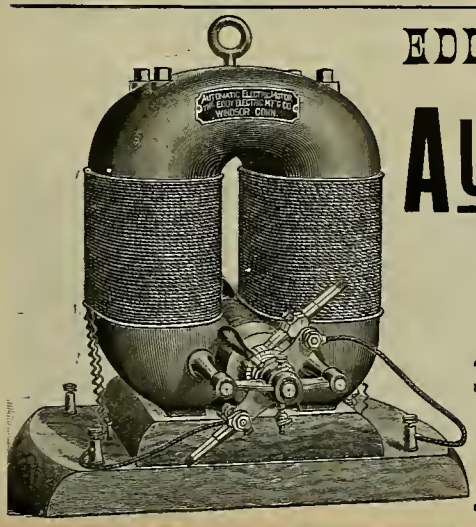

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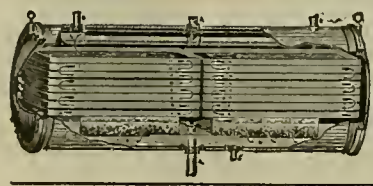

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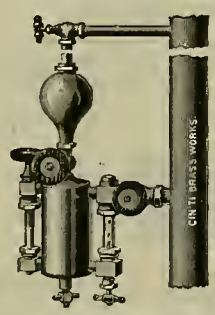

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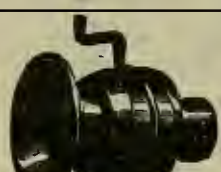

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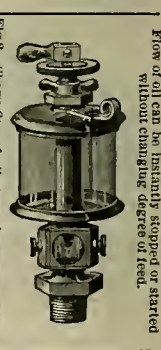

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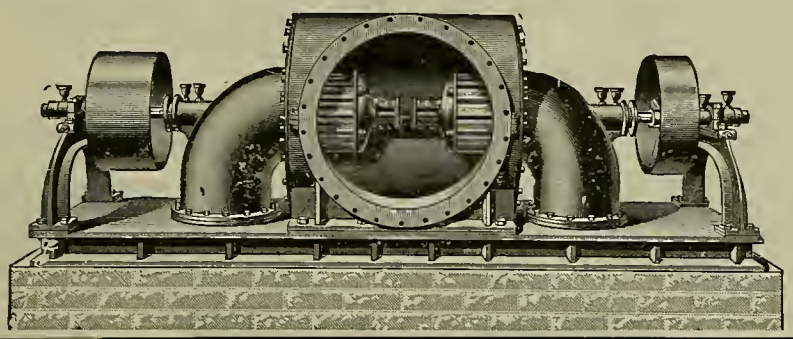

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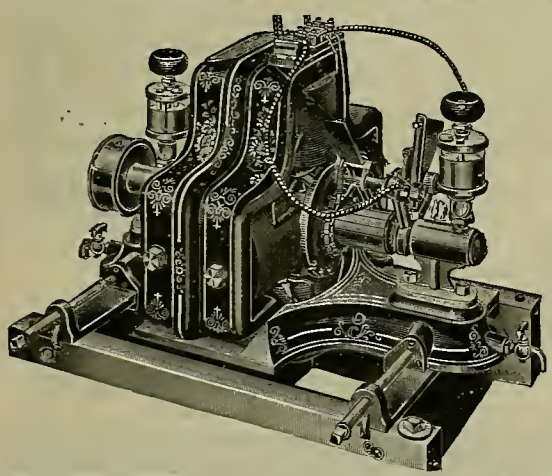

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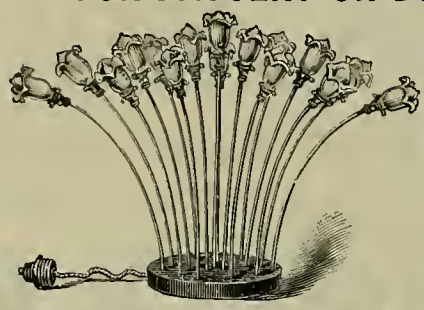

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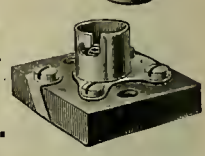

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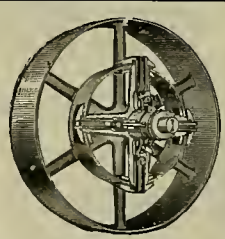

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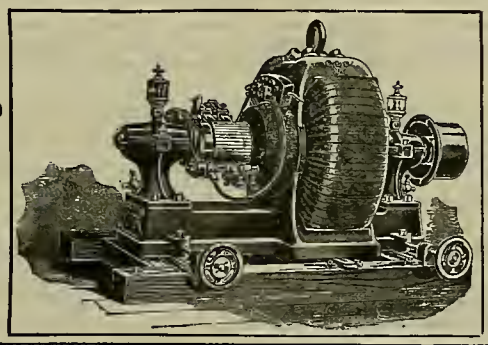

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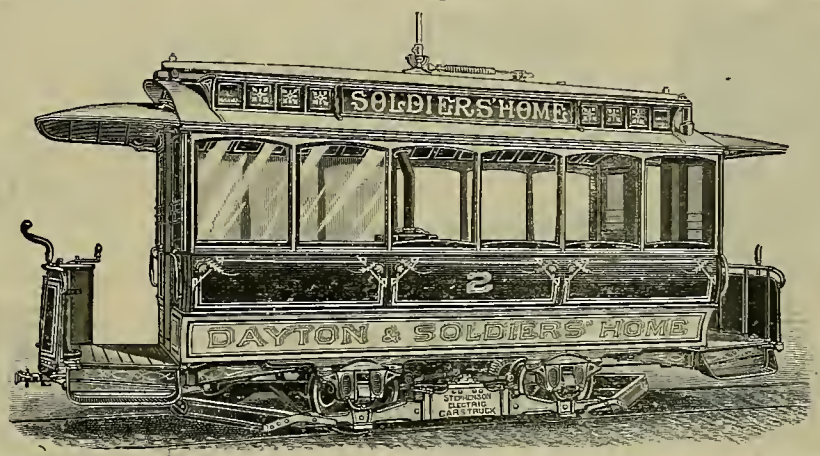

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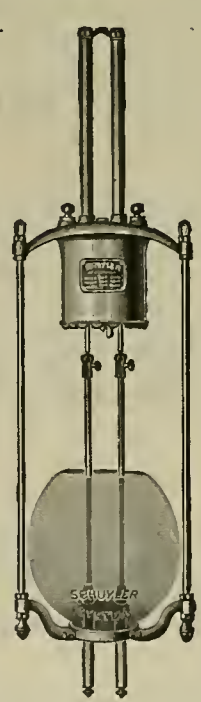

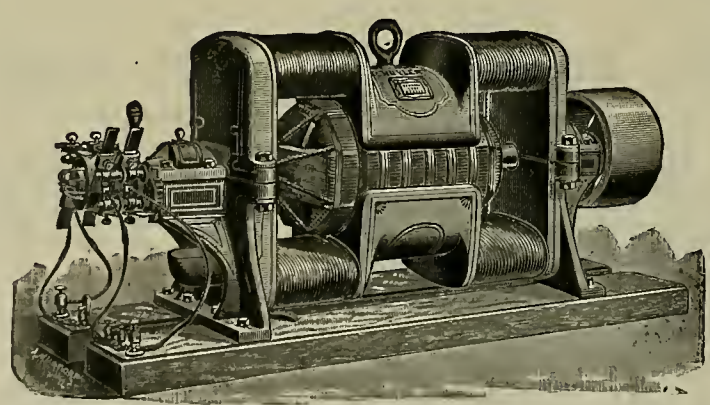

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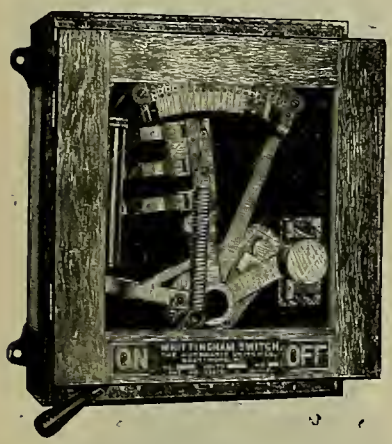

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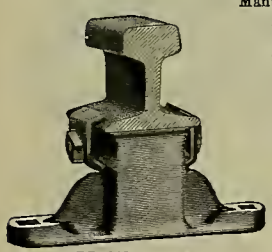

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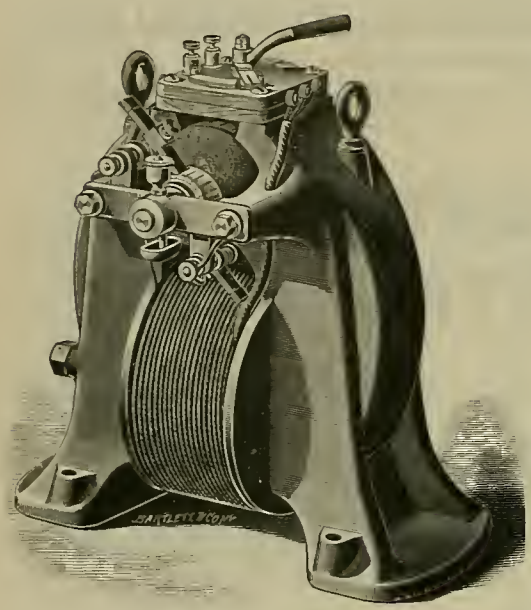

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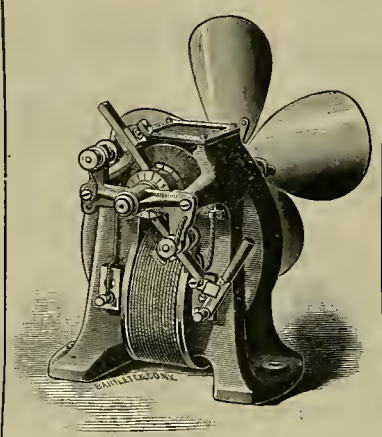

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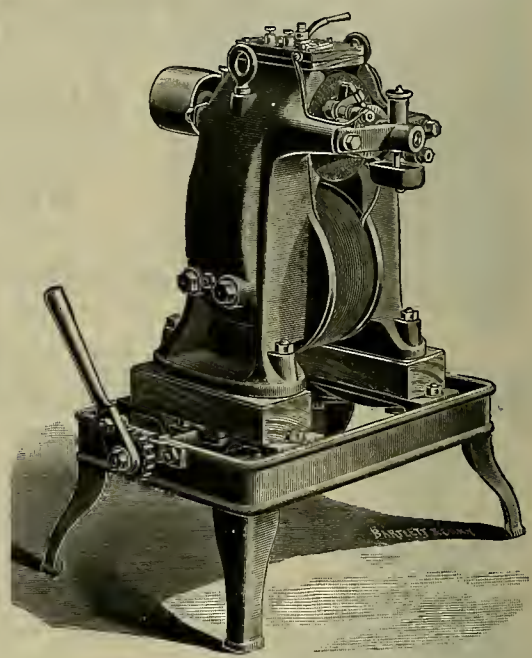

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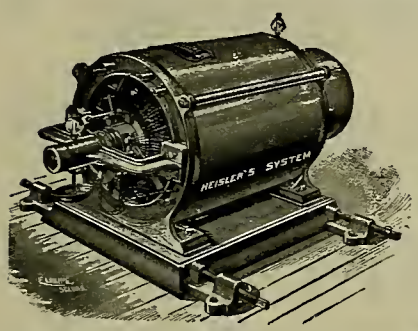

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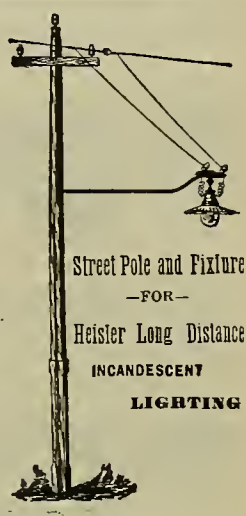

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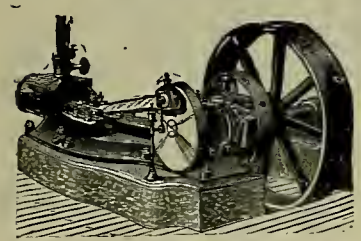

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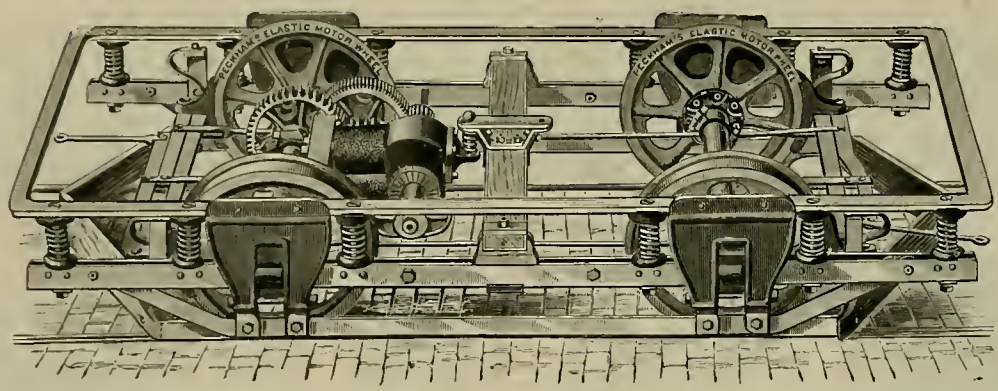

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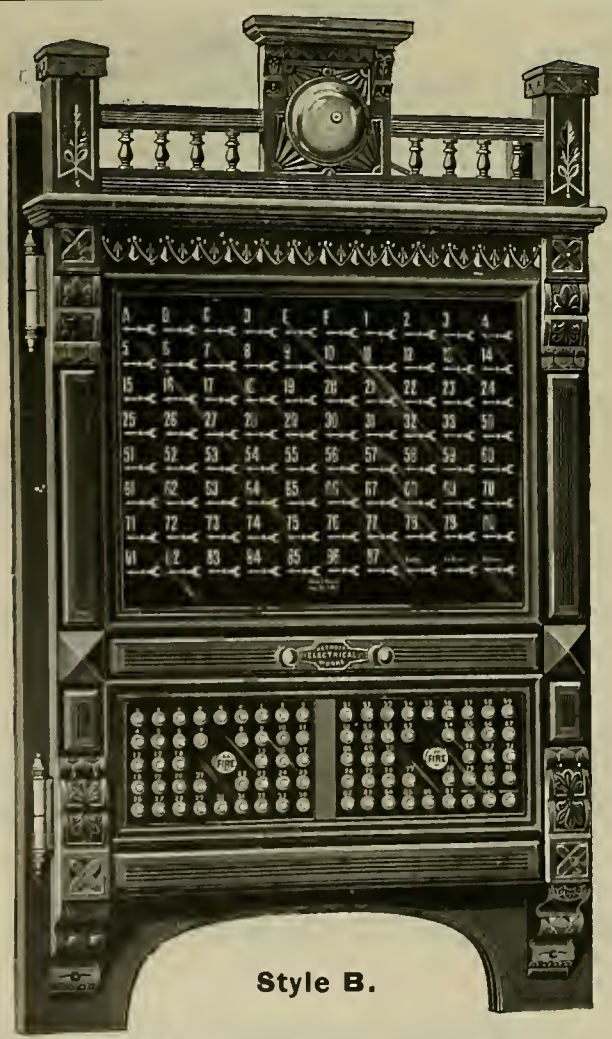

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219,208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219,208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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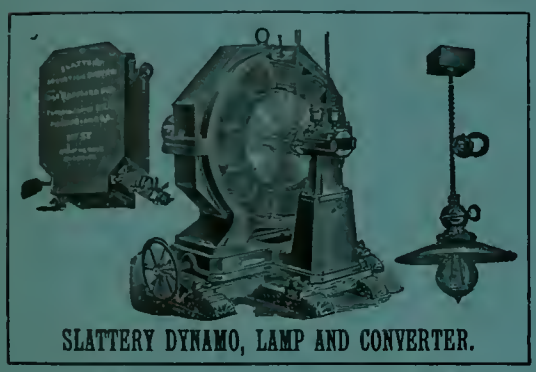

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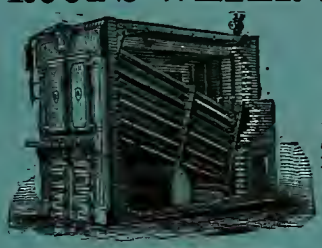

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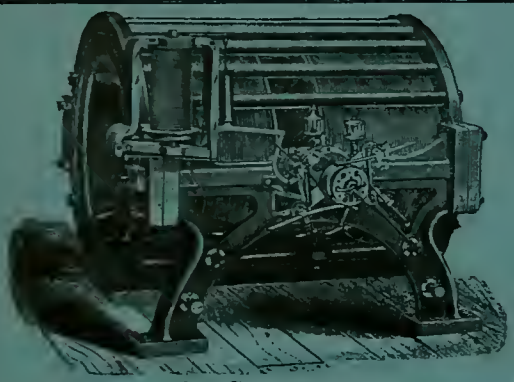

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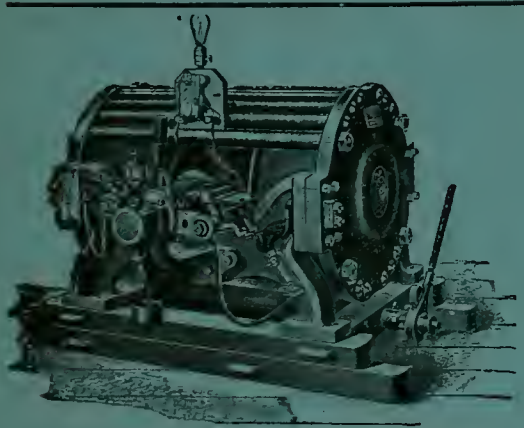

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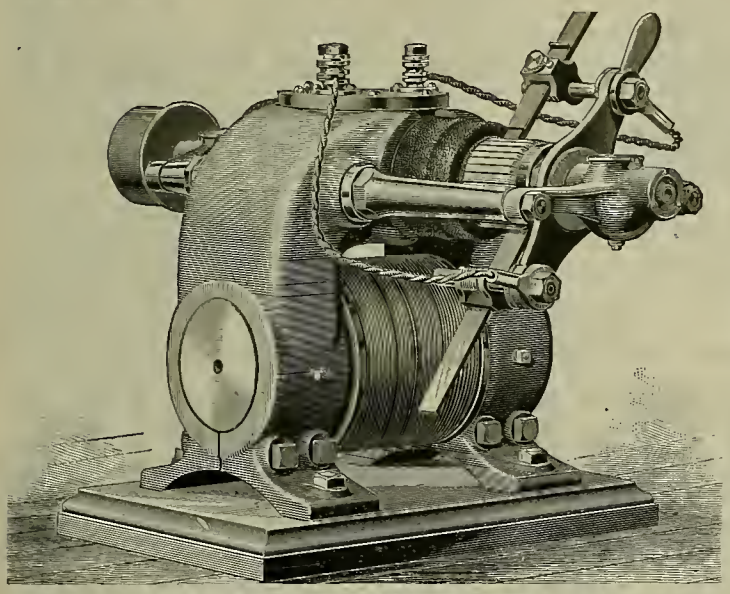

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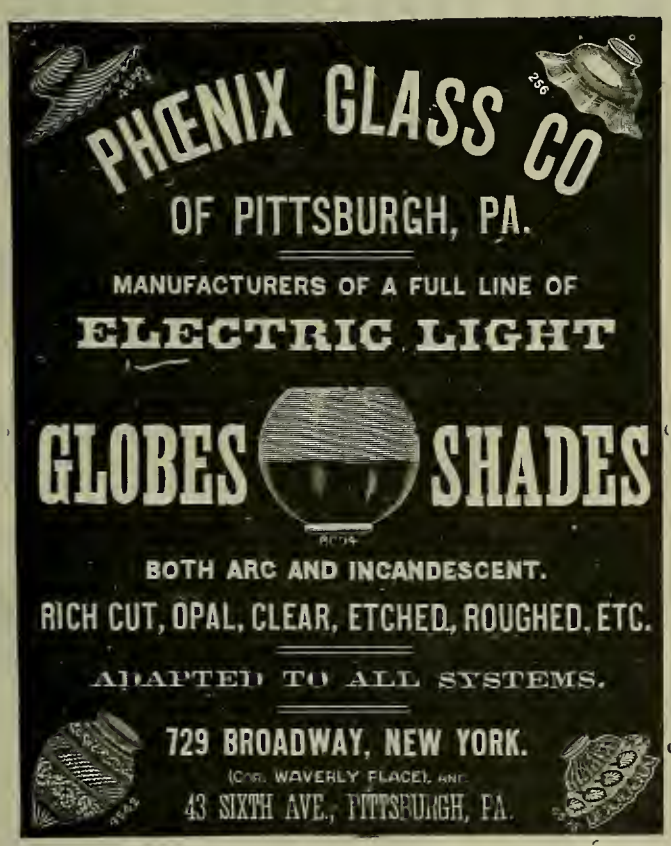

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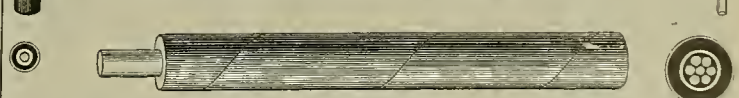

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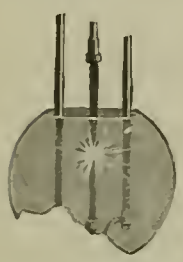

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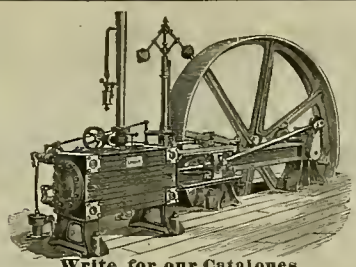

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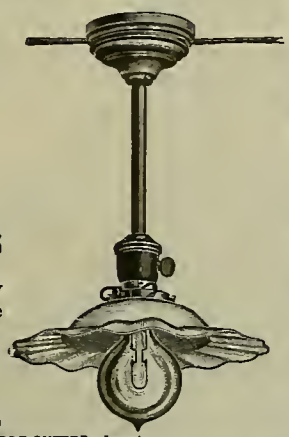

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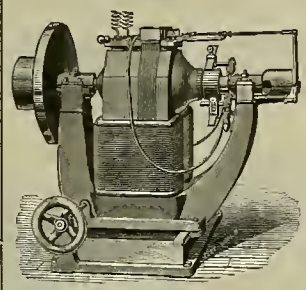

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16 Sizes, 5 to 500 H. P. Not yet equaled by any form of Engine for HIGH FUEL DUTY AND SIMPLICITY.

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3,000 in use in all parts of the Civilized World.

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AN AUTOMATIC ENGINE CHEAPER THAN A SLIDE VALVE.
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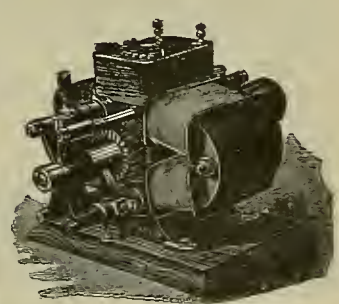

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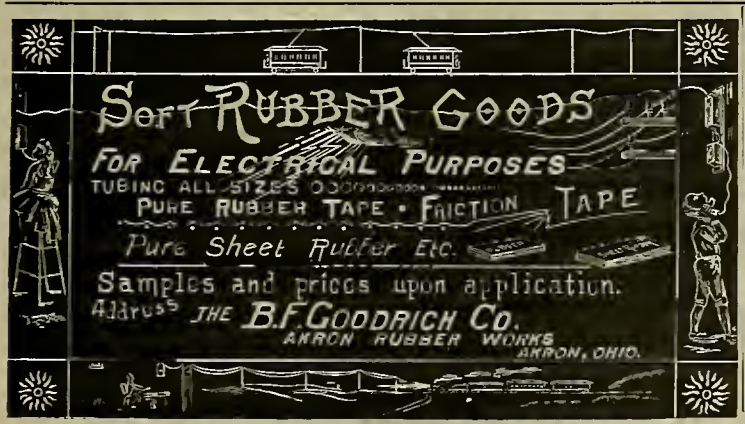
By Means of Which Higher Efficiency, Closer Regulation and Slower Speed

ARE OBTAINED THAN IS POSSIBLE OTHERWISE. ☞CAREFUL INVESTIGATION INVITED.



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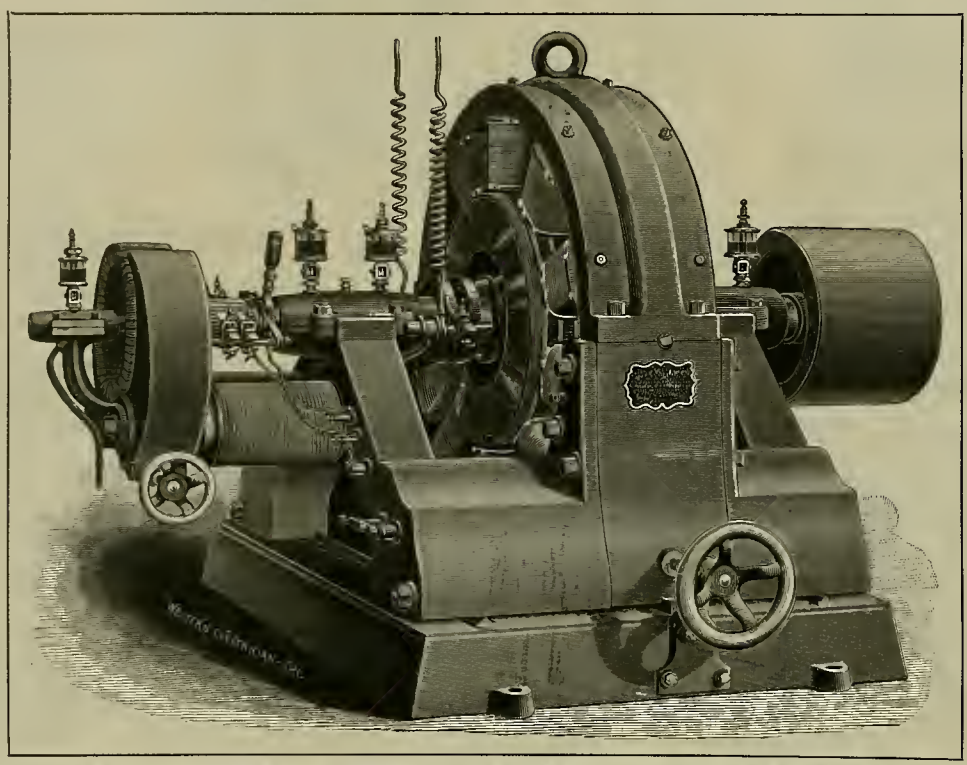

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WE GUARANTEE ITS OPERATION, AND

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Connected by Private Wire with Postal Telegraph Cable Co.

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1,000,000 FEET OF OKONITE WIRE

AND

300 MILES OF

CANDEE WEATHERPROOF WIRE.

IN SIZES TO SUIT THE DEMAND.

This stock is ***ACTUALLY ON HAND***, and orders can be promptly filled.

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SEND US A SAMPLE ORDER!

If You Want Anything Electrical, Write to Us. Lowest Prices.
Most Complete Stock. Quickest Shipment.

Wire.	All kinds from bare to highest grade of insulation made. We always carry a full stock of wire of all the best makes.
Flexible Cord.	Of all sizes, and every finish.
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Incandescent Lamps.	To fit any socket. All candle powers, any voltage, and any efficiency up to twenty lamps to horse power.
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Miscellaneous Articles.	Such as tape, rubber tubing, insulators, pins, cross-arms, solder, cleats, screws, insulating hooks, insulating compound, always in stock, and sold at best prices.
Supplies.	Of every kind in stock at New York, Chicago, Denver and San Francisco.
Agents.	Can be had anywhere within twenty-four hours.
Contracts for Installation.	We make contracts for complete installation, construction and all, and are directly responsible for everything about the plant. No sub-contractors. No division of responsibility.

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—IN—

Mills, Factories, Public Buildings, Hotels,

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ELECTRIC LIGHTING COMPANY,

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More than One Thousand Plants in Operation.

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SAWYER-MAN ELECTRIC CO.,

Incandescent Lamps and General Electrical Supplies.

"The lamps of the Sawyer-Man pattern in use on board (S. S. 'Omaha,') in many instances have shown a remarkably long life, several having a record of from 5,000 to 7,000 hours each."---Extract from report of Commander R. B. Bradford, Inspector of Electric Lighting, to the Chief of the Bureau of Navigation, Navy Department, for 1889 (page 27).

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WESTINGHOUSE ELECTRIC COMPANY.

Alternating Arc Lighting System.

Horizontal rays and a perfect distribution of light for street purposes. A marked contrast to the continuous current lamp which throws the most of the light on the ground directly under the lamp.

The most satisfactory arc light ever offered for street lighting purposes.

Machines from 25 to 125 lights' capacity.

Single carbon lamps running forty hours without renewal.

A full arc light for 7-10ths of a horse-power applied to dynamo.

Perfect automatic regulation of dynamo from one lamp to full load.

Machine may be run on a short circuit continuously without heating or damage.

No commutators to get out of order.

The greatest amount of light for a given amount of power.

In underground work, cost of circuits reduced to 2-5ths of that required for continuous current.

Converters used when lamps are run to buildings, giving low tension where lamps are accessible to users.

Particulars furnished on application.

System fully covered by patents.

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Boston. New York. Chicago. St. Louis. Cincinnati. San Francisco. Portland. Charlotte. Dallas.

Minneapolis, St. Paul, St. Louis.

THREE MORE LARGE CITIES FALL INTO LINE.

All the lines in Minneapolis and St. Paul and between those two cities, comprising 200 miles of track, are to be equipped with the Sprague Electric System.

(Statement of Mr. Thos. Lowry, Prest. of the Minneapolis Street Railway.)

"NEW YORK, Feb. 19, 1890.—I have to-day closed contract with Sprague Electric Railway & Motor Co. for the Electrical Equipment of the Street Railways in Minneapolis and St. Paul, and between those two cities."

(Signed) *THOS. LOWRY, Prest.*

St. Louis follows with an order for sixty-eight car equipments for the Lindell St. Railway in that city.

Total number of Street Railway Motors contracted for since January 1, 1890.----810.

Sprague Electric Railway & Motor Co.,

16 & 18 Broad St., New York.

Rialto Building, Chicago, and all Commercial Centers.

THE INTERIOR ELECTRICAL CONDUIT CO.

A New and Improved Method of Equipping Buildings with an Insulated Tube Conduit for any System of Electric Wiring.

COMBINING:

SAFETY—Absolute immunity from electric fires.
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DURABILITY—Absolutely moisture-proof tube and appliances, insuring longevity of wires.
CONVENIENCE—Systems of electric wiring may be laid out on original plans in a manner similar to that employed for gas, water and steam piping; the conductors may be drawn in at pleasure.

FOR CIRCULARS, PRICE LIST AND INSTRUCTIONS, ADDRESS,

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Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

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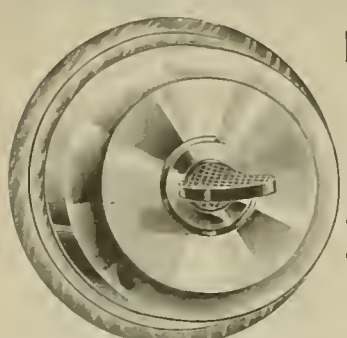

PAT. MARCH 12, 1889.

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Recognized as the best, simplest and most durable circuit breaker in existence.

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KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

USE THE BEST INSULATION.

The Celebrated P. & B. Electrical Compounds.

Thoroughly MOISTURE and WEATHERPROOF, resist the STRONGEST ALKALIS, STRONG ACIDS, FUMES and GASES.

ALSO P. & B. WATERPROOF

WRAPPING AND INSULATING PAPERS.

We manufacture a special VARNISH for ARMATURES and FIELD COILS

The Standard Paint Co., 59 Maiden Lane, New York.

Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, MARCH 22, 1890. No. 12.

Chicago City Electric Light Plant.

The North Side power house of the Chicago city electric light plant, which was recently completed, is illustrated in the accompanying cut. The station is a two-story brick structure, and is located at the corner of Chicago avenue and Sedgwick street. The engine room is on the ground floor, and the dynamos are arranged on the floor above. This portion of the building is covered by a slate roof, supported on iron trusses. In the rear of the engine room is the boiler room, and next to this are the coal sheds. An excellent view of the dynamo room, showing the position of the machines now installed, is given in the cut. The station was constructed with a view of accommodating machines for a 1,000 light plant, but at present there are only eight Thomson-Houston dynamos of 35 lights' capacity each. These machines are belted direct to four automatic high speed engines, built by A. L. Ide & Son of Springfield, Ill. These engines are of 150 horse power each, and run at 230 revolutions per minute. Each has two double belt driving pulleys of 68 inches diameter, and 22 inches face.

At present there are 25 miles of underground cable operated from this station, of the Standard, Patterson and Cobb types. At present there are 194 lamps on these circuits, but it is intended to increase this number to the full capacity of the plant as soon as the appropriation for the ensuing year is made.

The new Throop street station has been completed, and will be put into service immediately. It is Prof. Barrett's intention to transfer the electrical apparatus, now at the old power house at Jefferson and Van Buren streets, to this station, which is also equipped with Western electric machines. This will be the largest power station in the city service, as it will include 20 dynamos of the Western Electric company's make. The six new machines were tested Monday night, and proved in good condition.

Lamp Patent Litigation.

The Western Electric company of Chicago, has begun an action in the United States Circuit Court, Northern District of Illinois, against the Sperry Electric company of Chicago, for alleged infringement of the plaintiff's patent, 420,109. This patent was granted to Charles E. Scribner for single carbon arc lamps. It appears that the specification was sworn to Nov. 29, 1882, and the application was filed in the Patent Office Jan. 2, 1883. Owing to an interference and other delays, however, the patent did not issue until a little more than seven years later, Jan. 28, 1890. George P. Barton represents the plaintiff.

The Electric Improvement company of San Francisco, Cal., reports the installation of plants during 1889 of a capacity of 350 arc and 4,250 incandescent lamps. It has two important contracts which it has not yet completed, one is with the Palace hotel for 8,000, and the other the San Jose plant of 4,200 lamps.

Missing Electric Light Contract Discovered.

During the year 1882 two companies were working to secure franchises from the city council of Cincinnati authorizing them to conduct an electric light business with the privilege of erecting poles and stringing wires on certain streets. These companies were the Brush Electric Light company and the Cincinnati Electric Light company. The struggle for privileges became so warm that it was impossible for one company to secure a franchise without the consent of the other. A compromise was therefore agreed upon. Each company agreed that after it had erected poles it would allow the other to use them upon the payment of a certain portion of the expense of erecting the poles. The Brush company proceeded shortly after the granting of this franchise to construct a station and furnish electric light in certain portions of the city. About a year ago the franchise granted to the Cincinnati Electric Light company was purchased by Gen. Hickenlooper and his associates, and they proceeded to install a large plant and erect poles. On the strength of the old contract entered into by the Brush Electric Light company and the Cincinnati Electric Light company, the purchasers of the franchise of the latter company attempted to use the poles of the former company. The Brush company, on looking into this matter, was unable to find a contract in its records or in the minutes of the meetings of the board of directors, and no reference to any such contract

CHICAGO CITY ELECTRIC LIGHT PLANT—DYNAMO ROOM IN THE NORTH SIDE POWER STATION.

was made. Strange to say, the Cincinnati company's records were almost equally deficient in this respect. There was in the minutes of the meetings of the board of directors only a slight reference to such a contract. It was also unable to produce the contract alleged to have been entered into by the two companies and signed by the respective presidents of the companies.

FIG. 1. DUPLEX PIN AND INSULATOR.

The two presidents in the meantime had died. However, there was an abundance of testimony regarding the existence of such a contract at one time. The Cincinnati Electric Light company, on attempting to use the poles of the Brush company, was promptly enjoined from so doing. When the case came up for trial the advantage was clearly with the Brush company until, most unexpectedly to both sides, a clerk in the house of Post & Co. found the missing contract filed away among some old papers. The contract was brought into court, the genuineness of the signatures was established, and the decision of the court, of course, was given in favor of the Cincinnati Electric Light company. The judge took the occasion to state that he considered the Brush company entirely innocent of any attempt to suppress facts, as its records showed no contract of the kind claimed by the Cincinnati com-

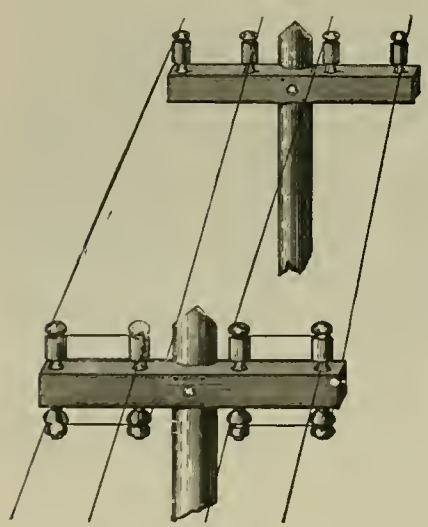

FIG. 2. DUPLEX PIN AND INSULATOR.

pany. It is not yet determined whether the case will be appealed or not. The missing contract it seems was formerly filed away among some private papers of Post & Co. of Cincinnati, in a vault in the basement of their store. During one of the floods in the Ohio River it was necessary to move these papers to the upper floor, and they were hastily taken up in packages. The electric light contract happened to be in the center of one of the packages of private papers of Post & Co., and had never been opened since it was moved from the lower vault to the upper floor. When its importance was discovered a systematic search was made for it, but it did not turn up until just in the nick of time.

Duplex Pin and Insulator.

The accompanying cuts illustrate a new style of insulator and pin, being introduced by the E. S. Greeley & Co. of New York. In Fig. 1 are shown the pin and insulator as they appear when detached from the cross-arm. Fig. 2 represents the manner in which the insulators are set, so as to facilitate the changing of the relative positions of the lines toward each other at every fourth or fifth pole, or as often as desirable. The advantage of this arrangement when applied to telephone lines for anti-induction purposes, is evident. The application of the device to a testing pole is shown in Fig. 3. The wire is fastened to the top insulator, and a continuation of it fastened to the lower insulator. Connection between the two is made by a short piece of soft copper wire, which can be readily removed for purposes of testing, and restored again to close the circuit.

In Fig. 4 the device is applied as a "break-arm" for the establishment of loops. Fig. 5 shows the application of the system to elevated railway and other similar structures. It will be

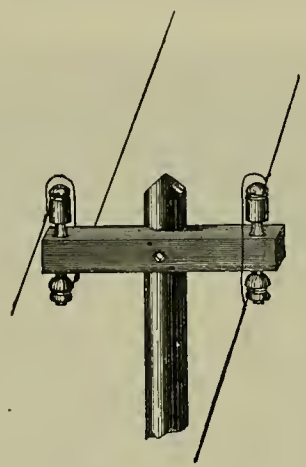

FIG. 3. DUPLEX PIN AND INSULATOR.

noted that not only is the distance between the various wires precisely the same with the use of this device as when the old style pin is employed with double the number of arms, but the strain of the wire is balanced so that there is no torsion upon the cross-arm.

Social Side of the Electric Railway.

At the last meeting of the New York Electrical society T. C. Martin read a paper on the "Social Side of the Electric Railway." Speaking of electric motor cars, he said: "They help a man get further away from his business, and yet bring him nearer to it. 'Rapid transit,' by their means, is no longer a deceiving phrase, or the proud monopoly of one or two big cities. The smallest city in the country is at once given a command it never had before over the territory around it. The smallest storekeeper or the humblest clerk can revel in the sweets of rural life, if he wish. His electric car, running at fifteen or twenty miles an hour, will give him more of home life—a few more golden minutes with the children in the morning, an earlier return to the wife at nightfall. The whole social atmosphere of the place is vivified, and the social bonds are knit closer, as they always must inevitably be where the facilities of travel are increased and the opportunities of intercourse are multiplied.

"Nor is this all. Rapid transit of this nature opens up a number of districts that before were practically inaccessible for residential purposes. There are few of us who care to practice the ancient form of dissipation known as early rising, agreeing rather with Charles Lamb in the idea that to rise with the lark or to go to bed with the sheep is a popular fallacy. There are still fewer of us who, even for the sake of rural delights, care to isolate and immure ourselves in remote suburbs, reached with difficulty. In vacation time, it is true, we often seek the loneliness of the woods, or the solitude of the mountain, that we may commune with Nature and hear the still small voice of our better self; but when we are doing the world's work fifty weeks in the year we want to be handily situated for reaching our desk or bench. If a man lives in the city, he pays a high rent and takes Irish views of the landlord question. If he lives far out, and wastes his time in travel, he is in hearty sympathy with the eight-hour movement. I look upon electric roads, therefore, as likely to prove a beneficial agency in the more equal distribution of a happier population around any center, thus increasing the return on outlying property, while by the encouragement of retail trade, enhancing the profit of the area lying within the region thereafter more legitimately restricted to business occupancy. I have watched with much interest the manner in which electric roads have already thus developed suburban areas. Booms are not a particularly healthy feature of progress, but they may be, and not infrequently are, genuine and real, and I know nothing more likely to bring on a real estate boom of the best character with permanent results than the installation of a well-managed electric road enabling a man to leave his work at 6 o'clock and be sitting down to his supper, seven or ten miles out, if he wish, under his own rooftree at 6:30.

"Having thus discussed the effects of electric roads on

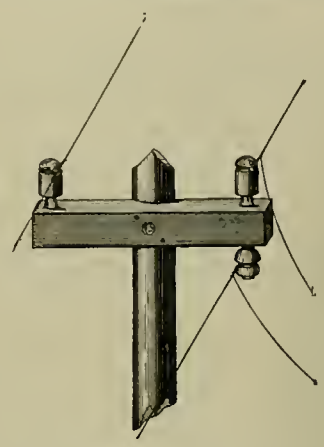

FIG. 4. DUPLEX PIN AND INSULATOR.

the community and on the individual citizen, I will add a word as to their effect on the wonderful impersonal entity 'capital.' If all that I have said be true as to the general benefits, it follows that the wealth and ease of the community are materially increased; but what I refer to now is not the direct enhancement of values, so hard to trace out, though so palpable, but the stimulus given to saving habits by the better opportunities of investment. Careful analysis of the working of electric roads goes to prove that when operated with skill and discretion they are fifty per cent. less expensive to run than horse railroads are. What does this mean? One thing it means is that many roads can be built that would be out of the question with horses. Another is that roads not paying can be placed on a dividend basis. In 1888 out of nineteen horse roads reporting in New York City, ten showed a deficiency. Last year their net earnings were much better, but it is evident that a horse road is not always a mine of wealth, though it may be of fertilizers. A third point is the establishing of a new class of investments of a solid, enduring nature. It is within everybody's knowledge that the accumulation of capital tends constantly to the reduction of interest to a minimum. There was a time when the long stocking and the iron chest were the common bankers for the savings of the timid; and the capital that was bold earned the double reward of its bravery and scarcity. As Walter Bagehot, the economist, has remarked, the English people have always wanted to put their money into something safe that will yield 5 per cent.; and this is undoubtedly one reason why English capital, free and fluent, is so much a power in the finance of the world, and why so much comes this way. As Mr. Bagehot says: 'In most countries most men are content to

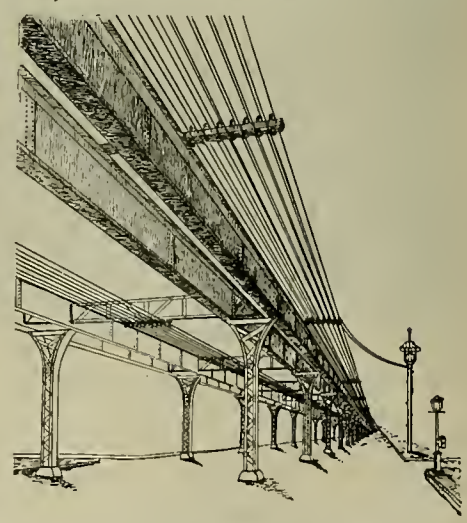

FIG. 5. DUPLEX PIN AND INSULATOR.

forego interest, but in more advanced countries at some times there are more savings seeking investment than there are known investments for.' It is thus in America, so far as 'safe' investments are concerned, and by safe I mean such as do not require the active care and ceaseless thought of the capitalist, but may be held by trustees, widows, hospitals, universities, savings banks and the like. The competition of capital for the best class of government bonds, municipal bonds, railroad stocks, etc., has reduced the earnings on these to a very low figure, whether in America or England or Germany; and the result is that we see to-day, as never before, the planning of enormous

trusts and gigantic industrial enterprises, which represent in no small degree the endeavor of capital or savings still to enjoy its wonted income, but in newer fields. Now I look upon the street railway business of the country, under the regime of electricity, as offering one of the best opportunities for local capital, and for what may be called the organization of local savings, which might otherwise lie around in napkins, like the unjust steward's talent, and be of no use to anybody. The capital in street railways in America to-day reaches from $175,000,000 to $200,000,000. If the statement I have made as to the superior economy of electrical power be true, how much greater becomes the earning capacity of this investment, how much greater are the attractions held out to construct the hundreds of new roads that are still wanted and will be called for as our towns and cities grow? Of course, I am aware that it may be said that this showing might lead to a demand for lower fares. It might but the public is intelligent enough to know that other things are more necessary, such as better cars, with better heat and better light, improved tracks, faster running time and shorter headway, so that the 1,500,000,000 passengers on the street railroads every year may travel in all safety and comfort. Street railroads are peculiarly suitable as a field for local investment. Their operation can be watched all the time. They run under a man's eye when he is on the street, or past his window when he is home. He knows something of their officials; he can influence the domestic legislation they are subject to; he can assist in more ways than one to swell their earnings."

Telephone Trouble in Chicago.

The Chicago Telephone company has notified Prof. Barrett that the patrons of its service have been complaining of trouble on the line since the city began operating its North Side plant, and that the company is satisfied that the interference is due to the operation of the city plant. It was at first thought that the trouble was due to leakage, but examinations by experts of the telephone company have led to the discovery that the trouble was caused by induction. Prof. Barrett replied that he would consider any statements the company would make, as well as any suggestions as to the best method of avoiding the difficulty. He is of the opinion that the trouble is not due to induction.

The University of Notre Dame, at South Bend, Ind., will be lighted with 12 Thomson-Houston arc lights.

Sending Pictures by Telegraph.

The accompanying cuts illustrate a method of transmitting sketches by telegraph. The advantages of such a method of communication lie in its applicability in time of war to telegraphing the position of an enemy, etc. It would also be useful in tracking a criminal, for his portrait could be transmitted rapidly from place to place. The method of working will be understood from the illustrations and the table. The original sketch is divided up into squares by means of ordinates and abscissæ, and each square is identified by the letters which are ranged along the sides of the chart. Each of these squares is again divided into five parts, which are identified by the numbers 1, 2, 3, 4, and 5, and each such part is divided into two, and half the part is denoted by the letter j. Any point in the picture thus has two co-ordinates, as in analytical geometry, and these co-ordinates are communicated by telegraph. A broken line is, of course, identified by a number of points taken along it. When the sketch has been reproduced by joining the points constituting the lines, the details may be filled in by the aid of the descriptive words added. The diagrams and table of the telegraphic message so fully explain the method that further comment is unnecessary. It may be of interest to add that the scene depicted in the specimen illustration is a view from Whitby Harbor. The cuts are reproduced from *Industries*. Following is the table giving the data for the construction of the diagrams, Figs. 1 and 2:

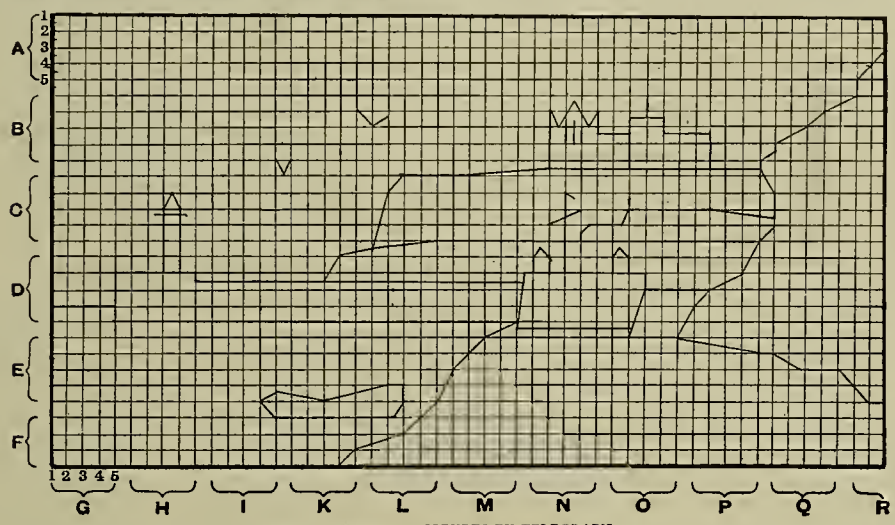

FIG. 1. SENDING PICTURES BY TELEGRAPH.

A_3R_3—A_5R_1—B_1R_1—B_2Q_4—B_4Q_1—B_4j Q_1—B_5P_5—B_5jP_5—C_2Q_1—C_4Q_1—C P_5—D_2P_4—D_3P_2—E_1O_5—E_2P_5—E_2 Q_1—E_3Q_3—E_3Q_5—E_5R_2—E_5R_3...	Foreground cliff.
D_3P_2—D_3O_3—E_1O_2—E_1O_5—D_3O_3...	Stone rampart (circular).
D_2O_3—D_2M_5j—D_5jM_5—D_5jO_2.....	
D_2N_1—D_1N_1—C_5jN_1j—D_1N_2—D_2N_2.	Watch houses (circular).
D_2O_1—D_1O_1—C_5jO_1j—D_1O_2—D_2O_2..	
D_2N_3—C_2N_3—C_2jN_3j	Flag staff.
C_4N_2—C_3N_4.....	
D_2jM_5j—D_2jH_5—D_2H_5—D_2G_5—D_5G_5 D_5M_5.....	Stone pier.
D_2H_3—C_3H_3—C_2H_3j—C_3H_4—D_2H_4.	Light house.
C_3jG_2j—C_3jH_4j.....	
D_4G_5—D_4G_1.....	Horizon.
D_5M_5—E_1M_3—E_3M_1—E_5L_5—F_2L_3— F_4K_5—F_5K_4.....	Water line.
E_5K_3—E_4jI_5—E_5I_4—E_5K_3—E_4L_2— E_4L_3—E_5L_3—F_1L_2j—F_1I_5—E_5I_4..	Boat.
B_5jP_5—B_5jN_2—C_1M_2—C_1L_3—C_2L_2— C_5jL_1—D_1K_4—D_2jK_3.....	Distant cliff.
B_5jN_2—B_2N_2—B_3N_2j—B_1jN_3j—B_3N_4j —B_2N_5—B_3jN_5—B_3jO_2.....	Abbey.
B_4N_3—B_3N_3.. B_4N_3j—B_2jN_3j B_4N_4—B_3N_4..	Windows.
B_5jO_2—B_2jO_2—B_2jO_4—B_3jO_4—B_3jP_2 —B_5jP_2—B_2jO_3—B_1jO_3....	Church.
C_5P_5—C_5L_5—D_1K_4—D_2jK_3.....	Lower ledge.
C_5N_4—C_4jN_4—C_4N_4j—C_4O_1j—C_3O_2 C_3P_2—C_3jO_1.....	Old houses.
B_2K_5—B_3L_1—B_2jL_2.....	Seagull.

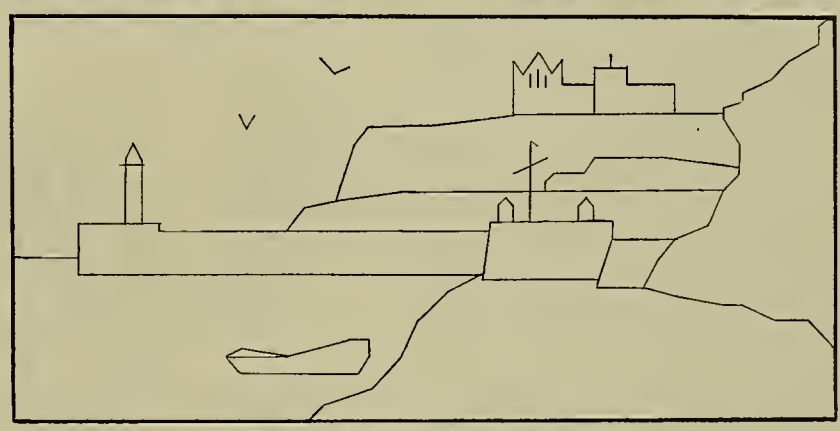

FIG. 2. SENDING PICTURES BY TELEGRAPH.

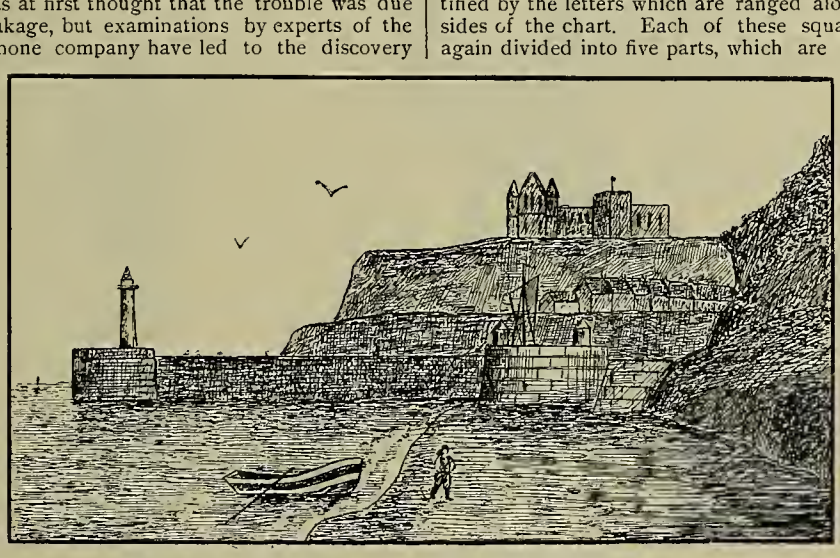

FIG. 3. SENDING PICTURES BY TELEGRAPH.

Chicago's Influence in Electric Circles.

"Chicago has been a disturbing element in electric lighting," said City Electrician Barrett of Chicago, last week, after dismissing a delegation of visiting officials, who had been inquiring about the operation of the electric system in that city.

"In the first place," continued the head of the Chicago electrical department, "the position of the city on underground wires started other communities in the same direction, and the telegraph and telephone as well as electric light companies were obliged to do something in the way of experimenting. The next movement that attracted attention was the establishment of a city electric light plant. It is now an established fact that electric lighting is the only proper means of street illumination, and I think we can safely say that we have demonstrated the fact that the city can do that kind of work a little better and at less expense than the commercial companies. Since these two features were introduced into the electrical problem in municipal service, we have had delegations galore. Chicago has been a sort of a Mecca for council committees, and they are always ready to make the pilgrimage when the Garden City is to be visited. I think that the position which we have taken here has raised the city in the estimation of the people throughout the country; they have come to respect the stand we took, which is in such striking contrast to the policy of New York. Of course, the electric companies which have been put to considerable expense through this action would be better pleased had they been let alone, but I hardly think it seriously interfered with them, for none of them has been badly crippled—they are still in business, and I guess they are not losing any money. At any rate, they maintain a prosperous appearance, and appear contented with their lot."

The committee of Buffalonians, which visited Chicago last week, carefully examined the underground system and the city plant, and secured considerable data from Prof. Barrett relative to the operation of the department and the best methods of construction. The committee will present these facts to the people of Buffalo on its return. The question of underground wires is again disturbing the minds of the electrical companies, and the interest manifested in a city electric light plant is anything but reassuring to the commercial companies which now furnish the street lights.

Theory of Accumulators.

By Prof. H. S. Carhart.

Every theory must stand or fall by the facts which support or oppose it. The theory of accumulators advanced by Dr. Schoop in his paper read before the Chicago Electric club, and printed in the Western Electrician of March 8, appears to fall so far short of explaining the facts that I propose to submit only a single consideration which renders it entirely useless to pursue that line of explanation further.

We shall take our point of departure from the change of density of the electrolyte during charge and discharge; and to make a concrete case we shall take the figures given in Dr. Schoop's paper. If a 200 ampere-hour cell contains 27 pounds of liquid of density 1.220 when fully charged, then the liquid contains 29.6 per cent. or 7.992 pounds of concentrated sulphuric acid.[1]

If the density is 1.175 when the cell is discharged, then the acid constitutes only 24 per cent. of the weight. If this change is due to disappearance of the acid, then about one and one-half pounds disappear during the discharge of 200 ampere-hours.

But if Dr. Schoop's theory is correct it must account for the dilution of the liquid by the addition of the water formed by the union of oxygen and hydrogen during the discharge, the oxygen coming from the positive plate and the hydrogen from the negative, the two gases being occluded or absorbed during the charging process. Dr. Schoop has made a singular mistake when he says: "The addition of about one-fifth of a pound of water to twenty-seven pounds of dilute acid of 1.220 specific gravity will give us the same specific gravity as the removal of one pound of sulphuric acid." No statement could be wider of the mark than this. Let us see how much water must be added to 27 pounds of the dilute acid of density 1.220, containing about eight pounds of acid, to reduce the density to 1.175, or so that the acid will constitute 24 per cent. of the whole mass. The simple question is, 8 pounds are 24 per cent. of how many pounds? The answer is, 33.3. Hence, 6.3 pounds of water must be added to the 27 pounds in order to effect the reduction of density from 1.220 to 1.175. This is in accordance with the tables, and I have verified it by experiment. It amounts to 23.3 per cent. by weight, or an addition of 28.4 per cent. by volume. Now, in the first place, no appreciable change in the volume of the liquid in the cell has ever been noted; certainly no such preposterous change as 28 per cent. ever takes place. But if the change in density is to be accounted for by the addition of water formed in the reaction accompanying the discharge, then there is no way to avoid the above conclusion.

Let us consider further the energy involved in this transaction. One-ninth of the weight of water added is hydrogen, equal to seven-tenths of a pound or 317 grammes. The heat of combination of one gm. of hydrogen with oxygen is 34,000 gm. degrees, or 1.43×10^{12} ergs. Hence the 317 gms. of hydrogen by union with oxygen will produce:

$317 \times 1.43\times10^{12}=453.31\times10^{12}$ ergs of energy.

Two ampere-volts for one hour equal $2\times3600\times10^{7}=72\times10^{9}$ ergs, since the product of one volt by one ampere equals 10^{7} ergs.

If, therefore, the 317 gms. of hydrogen unite with oxygen and the energy is all transformed into that of a two-volt current, the number of ampere-hours furnished by the cell would be:

$453.31\times10^{12}\div72\times10^{9}=6,296$ ampere-hours. If, therefore, the storage is due to occluded oxygen and hydrogen, then such a cell, containing 27 pounds of liquid, should have a capacity of about 7,000 ampere-hours. The actual capacity is only one thirty-fifth of this. Or again, the electro-chemical equivalent of hydrogen is 0.00001035 gms. per coulomb. Hence, to produce 317 gms. of hydrogen from water would require $317\div0.00001035=30,628,000$ coulombs of electricity. One ampere-hour equals 3,600 coulombs. Hence, $30,628,000\div3,600=8,500$ ampere-hours of charging would be required to produce the 317 gms. or seven-tenths of a pound of hydrogen from 6.3 pounds of water, which, by its withdrawal from the liquid, would raise the density from 1.175 to 1.220.

The volume of this gas under standard conditions would be 3,538 liters, or 778 gallons. This would come from three-fifths of a gallon of water, which would have to disappear and reappear in every 200 ampere-hour cell with each charge and discharge. Is it not apparent that Dr. Schoop's theory does not "hold (enough) water"?

The reactions in a storage battery are undoubtedly very complex. It is altogether probable that occluded oxygen and hydrogen take some slight part in the process; but that the potential chemical energy of dissociated oxygen and hydrogen accounts for any considerable portion of the energy in the form of an electric current, furnished by an accumulator, no one can believe when he looks at such facts as I have presented above.

[1] Roscoe and Schorlemmer's Chemistry, Vol. I, p. 342.

Accumulators for Galvanoplastic Work.

By Dr. Paul Schoop.

Many interesting facts are to be found in the application of the storage batteries to galvanoplastic work. In the works of Benziger & Co., Einsiedeln, Switzerland, an electrotyping plant is operated, consisting of two dynamos, each with a capacity of 300 to 400 amperes at from 1.5 to 2 volts. About a dozen galvanic baths are used. These stoneware vessels, each of which is 3 feet high, 4 feet long and 2½ feet wide, were formerly connected with one of the dynamos, the other machine being kept as a reserve. The electrolytic vessels, each of which has a capacity of about 100 gallons, contain a solution of sulphate of copper with a density of 20 degrees Beaume acidulated with sufficient sulphuric acid to raise the density to 21 degrees. Fig. 1 illustrates the method of conducting the current by means of heavy copper bars to the electrolytic vessels, which are all connected in parallel. A sheet of copper *N*, about 3 to 5 millimeters in thickness, is suspended on a copper rod *C*, which lies on the positive branch *P*. Contact with the negative branch *N*, is prevented by the glass insulator *G*, which is slipped over the copper rod. The matrices *T*, which are to be coated with copper, are attached to a lead plate about 2½ millimeters in thickness. The spaces which remain uncovered on the plate are filled with wax. The lead plate is also suspended on a copper rod *C*', which is in contact with the negative branch, and insulated from the positive branch by a glass insulator. Each bath contains half a dozen copper sheets (anodes) and five matrix sheets (cathodes). The distance between each anode and cathode is 3½ to 5 cm. The pressure between the two poles in the electrolytic vessel is constantly maintained at from .80 to 1 volt. The exposure is continued from 12 to 24 hours, the thickness of the coating ranging from .75 millimeter to 1.5 millimeters. The amount of current flowing in the different electrolytic vessels depends entirely upon the surface of the electrodes contained in them. The greater the number of matrices exposed in a vessel the greater the amount of current consumed. It is not necessary, therefore, to regulate the current, as the

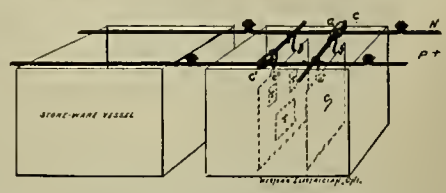

FIG. 1. ACCUMULATORS FOR GALVANOPLASTIC WORK.

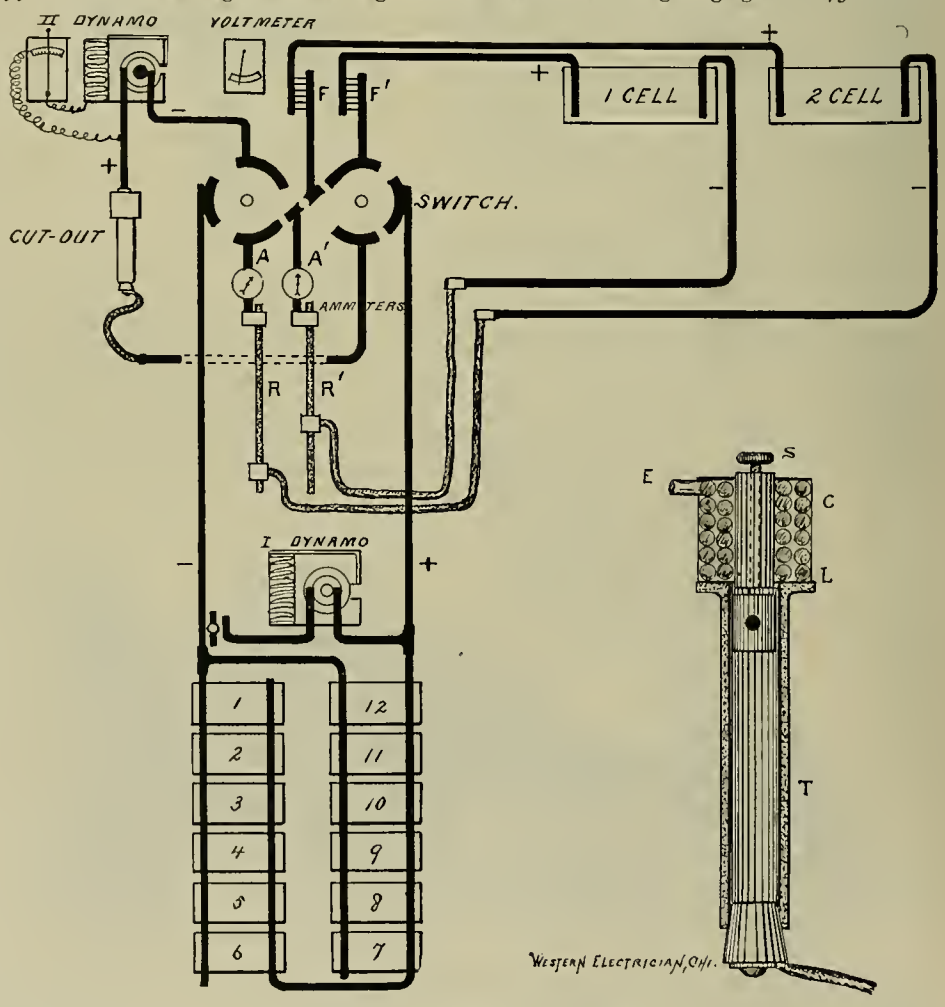

FIG. 3. ACCUMULATORS FOR GALVANOPLASTIC WORK.

FIG. 4.

surface exposed regulates it automatically if constant pressure is maintained. Fig. 2 shows the arrangement of the plant before accumulators were used. The storage cells were added to the original plant so that it might be possible to continue the work during the night. By the present arrangement the first dynamo, as previously, provides current for the electrolytic baths during the daytime (300 amperes for 12

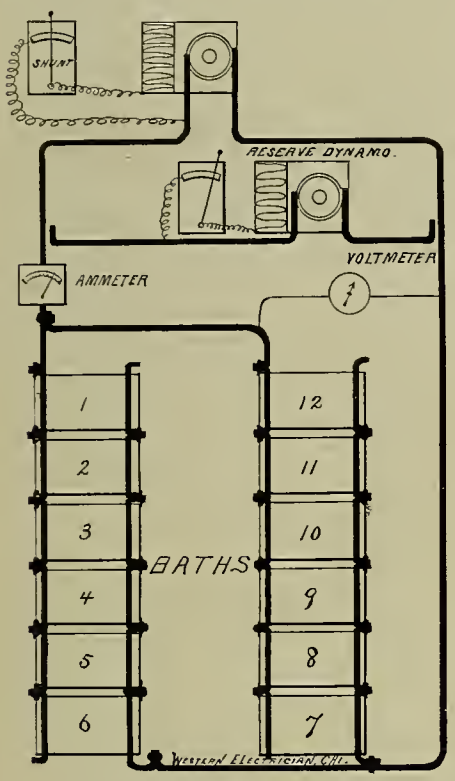

FIG. 2. ACCUMULATORS FOR GALVANOPLASTIC WORK.

hours). The second dynamo, which was used as a reserve, is now employed for charging the accumulators during the daytime. At night dynamo No. 1 is disconnected and the accumulators are connected to the electrolytic baths. By means of a special form of switch it is possible to charge the two cells in series and to discharge them in parallel. Fig. 3 shows the connections of this switch with the charging dynamo and the two accumulator cells and the electrolytic vessels. In Fig. 6 is shown the position of the switch when the cells are being charged; Fig. 5 shows its position when they are discharging. The switch was designed by Mr. Huber of the Oerlikon works. In the negative branch of each accumulator, Fig. 3, are inserted the ampere meters A and A^1, which read up to 250 amperes, and resistances R and R^1. In the positive branch of each cell are inserted lead safety fuses F and F^1. The two resistances R and R^1 are necessary in order that the current of each cell may be discharged at exactly the same rate. They are made of an iron tube ¾ of an inch in diameter and 3 feet long. One end of the tube is connected with the ampere meter and the other end to a copper clamp which leads by means of a thick cable to the negative pole of the cell. In the positive branch of the charging circuit from the dynamo is inserted an automatic cut-out, the general appearance of which is shown in Fig. 4. The iron core S is surrounded by a coil C. The current enters at E in the coil C and leaves at L, which point is connected to the copper tube T. The end of this copper tube is closed by a copper plug, from which a cable conducts the current further on. A cylindric piece of iron moves freely up and down in the tube T. When the plug is slipped into the tube the current flows through the coil C and the iron core S becomes magnetic; the iron cylinder is lifted to the top of the tube and is held there by magnetic force. The screw makes it possible to keep this little cylinder at the proper distance from the magnet in accordance with the amount of current. If for any reason the current should tend to flow from the cells to the dynamo, the magnetism momentarily decreases and the cylinder falls, forcing out the plug, and the circuit is then of course broken.

The following table gives the data of charging the cells in series:

Time of starting.	Current, amperes.	Element I, Volts.	Element II, Volts.	Dynamo, Volts.
7 A. M.....	200	2.00	2.00	4.10
10 A. M.....	200	2.05	2.05	4.15
1 P. M.....	190	2.10	2.10	4.20
4 P. M.....	180	2.15	2.15	4.40
7 P. M.....	150	2.20	2.17	4.50

Interrupted at 7 P. M. Tension at 8 P. M., Element I, 1.95 volts; Element II, 1.95 volts.
The whole charge is 2 250 ampere-hours (4 volts).

In the following table are given the data of discharging the cells in parallel:

Time of starting.	Current, amperes.	Element I, Volts.	Element II, Volts.	Baths, Volts.
8 P. M.....	300	1.70	1.70	1.00
6 A. M.....	280	1.67	1.63	1.00
10 A. M.....	270	1.65	1.65	1.00
12 A. M.....	240	1.70	1.67	1.00

Interrupted at 12 A. M. Tension, Element I, 1.90; element II, 1 90.
The discharge is 4,460 ampere hours (2 volts)

No difference was found in the deposit effected by means of the accumulator current compared with the deposit obtained by direct dynamo current. It is only necessary to keep the baths properly acidulated. If there is a deficiency of acid, the deposit is a dark reddish brown instead of a bright yellow reddish color, which is obtained in a bath of good solution. These accumulator-cells made by the Oerlikon works, Switzerland, are of a somewhat different construction from those usually employed. The plates are so made and the means for introducing the current to the plates so disposed that a perfectly equal distribution of the charging or discharging current over the whole surface of each plate is obtained. The current enters in the center of the negative plate, and leaves the positive plate on its edges. All the positive plates are connected together at the four corners. While the effect of this arrangement is scarcely noticeable in ordinary slow charging or discharging, it is plainly seen when the rates are four or five times greater. When the plates are without this feature and a high rate of charge or discharge is necessary, the contrast is marked.

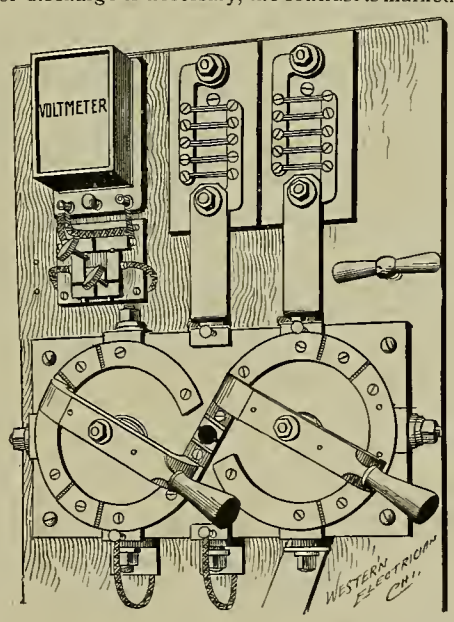

FIG. 5.

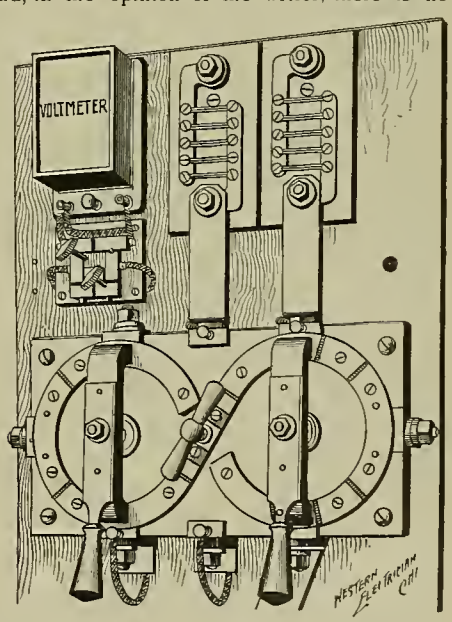

FIG. 6.

ACCUMULATORS FOR GALVANOPLASTIC WORK.

Each plate is 28 centimeters square and 5 millimeters in thickness. The battery is composed of 111 plates, 55 positive and 56 negative. The total weight of the plates and the connections is 405 kilos; the weight of the electrolyte is 200kilos; the weight of the lead-lined wooden box is 100 kilos, and the capacity in ampere hours is 2,200.

A feature in favor of these cells is to be found in the fact that the containing vessels are filled with a mixture instead of dilute sulphuric acid. In this mixture, which becomes solid after a short time, the dilute sulphuric acid is converted into a gelatinous mass. This result is effected by the addition of a proper amount of silicate of soda or potassium to the dilute sulphuric acid. The resistance of the gelatinous electrolyte is practically the same as that of the dilute sulphuric acid. The chemical reactions are the same in the cells as those containing the ordinary dilute acid electrolyte. The management of these accumulators does not differ essentially from that employed in the case of other types of cells. The charging of these accumulators, however, should be done with a constant pressure at the poles of the cell, and not with the usual constant current. By this method the tension of current from beginning to the end of charging is the same, say 2.15 volts per cell. As the cell or battery is supposed to be discharged, a large amount of current flows at the start. As the plates become saturated the charging current diminishes until at a certain point the counter electromotive force of the cells is equal to the charging tension of the current. The further entering of current therefore is stopped. By this method charging may be completed in a shorter time than by the more common plan of charging with constant current. The employment of automatic apparatus in charging is unnecessary in the former case. If the electromotive force of the dynamo is maintained constant the charging regulates itself automatically. The development of gas bubbles is also entirely prevented.

The method of gelatinizing the electrolyte presents many advantages. The scaling of the plates and the falling away of particles and the consequent short-circuiting of the plates are all prevented. A break of the glass or ebonite vessel does not interfere with the discharging current, as no fluid can escape. Under the same conditions a cell filled with gelatinized electrolyte permits a higher rate of charge or discharge than a similar cell filled with dilute acid. The gelatinized electrolyte is of course convenient in cases when it is necessary to move the batteries. The expense connected with gelatinizing the electrolyte is trifling, amounting to about double the cost of the dilute acid. The efficiency varies from 80 to 95 per cent., according to the amount of current. The reliability of the cell is far greater than with the fluid electrolyte. During the last year a considerable number of batteries have been made with the new electrolyte in England and on the Continent, and, in the opinion of the writer, there is no doubt that after a short time the use of the liquid acid will be entirely superseded and the gelatinized form used exclusively, both for paste accumulators and for accumulators which are made without the use of paste or cement.

Decision in Favor of the Brush Company.

The following dispatch has been received from the Brush Electric company of Cleveland: "Judge Coxe has handed down a decision in our case against the Julien Electric company in New York, broadly sustaining our foundation rights to the control of all practicable forms of secondary batteries."

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J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE recent negotiations in electric railways give evidence of the faith of capitalists in the new system of street car propulsion. One capitalist alone, it is stated, has invested over $5,000,000 during the last few months in street railways which he proposes to convert into electric roads. The subject is alluded to in the New York letter.

THE New York assembly has refused to adopt the amendment to that section of the electrical execution law prohibiting the publication of any of the details attending the infliction of the death penalty. This action can only be explained by the statement that the legislators of New York are opposed to the liberty of the press. The "moss-back" representatives of rural districts thought this would be a good chance, undoubtedly, to square accounts with some of the papers that have exposed their ludicrous views.

MANAGERS of gas companies give additional evidence each year of their growing conviction that the electric light is in the ascendancy. At the last meeting of the New England Exchange of Gas Engineers, an officer of a gas company read a paper on the management of electric light stations in connection with gas plants. An abstract of the paper is given in another column. He says the gas company with which he is connected purchased an electric light plant, and although it was careful to guard against the enlargement of the electric business at the expense of the gas, yet in eighteen months the increase in the electrical output of the plant was 60 per cent. This is certainly a remarkable admission, but it is no more so than others in the same paper. One of these is that there is nothing to be gained by evading the issue between gas and arc lamps, and there is no denying the fact, says Mr. Fowler, that the arc lamp is far superior to gas for street illumination. In the discussion on this interesting paper another member of the association paid a tribute to the ability of those engaged in electric lighting, both in the commercial and scientific departments. He also admits that electric lighting is what the people want, and that they will insist upon having it. In view of this fact, gas companies are urged to lay aside their prejudices and engage in electric lighting while the field is still open.

ELSEWHERE in this issue is presented a paper by Dr. Louis Bell on "Electric Motors for General Railroad Work," which was read at the last meeting of the Chicago Electric club. The subject is treated in a thorough manner, and the problems are well worked out. The fact that in electric railway work there is a tendency in the direction of increasing the size of motors and of adding to the number of trailers, has led naturally to the consideration of the problem of operating electrically regular railroad trains. The question whether motors can be built sufficiently powerful and reliable to handle trains at railroad speed is answered generally in the affirmative by Prof. Bell. The immediate solution of the problem of distributing the power is to be found, he says, in the operation of a railroad in reasonable sections. Just what the proper divisions should be must be determined separately in the case of each road which is to be equipped with the electric system. Prof. Bell works out one example in which he finds it entirely practical to locate power houses in the center of sections of twenty miles. As a further illustration, the problem of operating by electricity the "Big Four" road from Chicago to Cincinnati, a distance of 300 miles, by electricity is considered. The road is divided into sections of thirty miles, in the center of which generating stations are located. According to his estimate the system on one of these divisions which is selected as an example, would have a general efficiency of 50 per cent. At this rate no special economy would be found in the use of electricity, but still its adoption might result in reduced expenses inasmuch as a cheaper grade of coal might be burned, as better firing would be possible, and the weight of the motor might be made less than that of the locomotives, as according to Prof. Bell's view, the electric current tends to increase the traction. This is the general conclusion in regard to the operation of long lines, but in the case of short lines between two neighboring cities and suburban roads the substitution of the electric motor system would present substantial advantages, not the least of which would be reduced expenses. The use of electric motor trains on elevated roads is not only perfectly practical, says Prof. Bell, but there is no excuse at the present time for the operation of a single locomotive on such lines. He refers to the "L" roads in New York City, and estimates that the substitution of electric motors would reduce the coal bills from $700,000 per year to $300,000. The use of electric motors on elevated roads is only a question of time, says Prof. Bell in conclusion.

ELECTRICAL journalism promises to be exceedingly interesting in New York for the next few months. Already significant changes have occurred, which, although not entirely unlooked for, still in many respects are of a surprising nature. T. C. Martin and Joseph Wetzler, for years the editors of the *Electrical World*, have retired from the staff of that journal, and rumor has it that their retirement was somewhat suddenly and unceremoniously effected. This report was followed by the announcement that Mr. Martin and Mr. Wetzler had cast in their fortunes with George M. Phelps, of the *Electrical Engineer*, and that this journal was to appear as a weekly after April 1. The company which is to publish the new weekly has selected Mr. Phelps as president and Mr. Colvin as secretary and treasurer. Messrs. Martin and Wetzler will have the editorial management. It is to be hoped that the new company will not, as has been rumored, allow its stock to be taken by supply and manufacturing men. Nothing would more seriously operate against the success of the new venture.

That the *Electrical World* has lost strength and prestige by the enforced retirement of the gentlemen who for years have had editorial charge of the paper, seems to be the prevailing impression. Those who share in this impression are unkind enough to refer to the last number of the *World* as proof positive of the truth of their belief. The last issue of the paper in question certainly was not up to the mark, but it is hoped that this sudden lowering of the standard will be only temporary. It certainly would be a matter of general regret if the *World* should assume permanently that indifferent character which is so noticeable in journals conducted by managers without newspaper experience. The leading electrical newspapers have, up to the present time, maintained a high standard of excellence compared with publications representing other fields of industry, and this standard should not be lowered.

Changes in addition to those mentioned are reported. Messrs. Colvin and Shaw, of the *Electrical World*, have left their positions and have joined the staff of the new *Electrical Engineer*. Dr. Louis Bell of Chicago, has assumed the position of editor-in-chief of the *World* in place of Mr. Martin. Dr. Bell is a cultivated gentleman who has an ample technical knowledge. He has been a college professor, but his newspaper experience, we believe, has not been extensive.

To remodel the eminently respectable but slow, easy-going *Electrical Engineer*, to change it into an enterprising, wide-awake weekly, able to hold its own in a field in which the sharpest competition will be felt, is a task of no mean proportions, amounting, as it does, practically, to the establishment of a new paper. Still the new weekly has many advantages. Messrs. Martin and Wetzler are accomplished newpaper men and genial gentlemen, and their ability and popularity will now be supplemented by a liberal policy on the part of the new management, an advantage which the editors, by way of contrast, will very keenly appreciate. Mr. Phelps is a gentleman of great personal popularity, and he enjoys a wide acquaintance in the electrical field. His newspaper experience has been in the right direction to enable him wisely to manage the affairs of the new weekly. The *Electrical Engineer* has our heartiest wishes for its entire success. The task which its projectors have before them, however, is not one which will excite envy in the heart of the average newspaper man. It is a fact, not generally understood perhaps, that there will never be more than two entirely successful electrical newspapers published in the country. One of these journals, as a representative of the west, will be issued in Chicago, and the other, representing the east, will be published in New York city; they alone will be strong, vigorous, influential papers, with large circulations and a heavy advertising patronage. There will be other feeble publications which will struggle along and perhaps finally die, and their places will be filled by other journals whose existence will be equally precarious. The physical characteristics are such that these two papers, one published in Chicago and the other in New York, one west and one east, are bound to do the bulk of the electrical newspaper business of the United States. It would not be a difficult matter to name the paper which is destined to be, and is, in fact, the western representative; but in the present complicated condition of affairs in New York, with the prospect of a bitter struggle for supremacy, the name of the representative of the eastern field might not be selected with equal success.

While complications beset the New York electrical journals, the WESTERN ELECTRICIAN, with the great central and Western states for its territory, goes steadily ahead, serving its patrons better than any other electrical journal in the world. For all its electrical contemporaries, big and little, successful or unfortunate, the WESTERN ELECTRICIAN entertains a hearty regard, and desires to see them all secure an abundant measure of success.

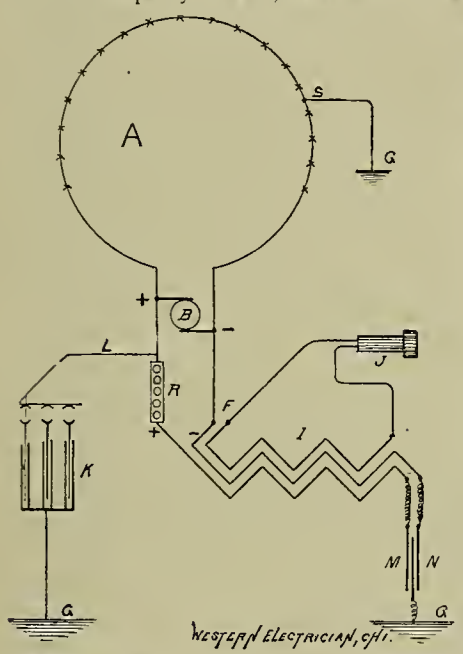
Method of Measuring Grounds on Arc Light Circuits.

By J. J. O'Connell.

The diagram presented herewith illustrates a method of measuring the insulation resistance of an arc light circuit while the current is on the line. The plan, which will be described, suggested itself to the writer after experiences in telephone work with a differentially wound coil and condensers. While the method has not, as yet, been subjected to a practical test, it is submitted to the readers of the Western Electrician for criticism.

Referring to the diagram, *A* represents an arc light circuit with a ground at *S*; *B* is the dynamo, with its poles marked + and — ; *M* and *N* are two condensers equally exposed to the earth; *K* is an auxiliary set of condensers; *J* is what might be termed a differentially wound induction coil—that is, one in which the secondary coil is divided into two parts, in which if equal currents circulate in the same direction they will oppose each other and neutralize any inductive effect on an outside conductor. The primary of the coil, *I*, is connected with a telephone, *J*. At *R* is represented a special resistance which will be referred to subsequently.

To explain the action of the apparatus it is assumed that the cable is well insulated and is of uniform capacity—that is, the same kind of a



METHOD OF MEASURING GROUNDS ON ARC LIGHT CIRCUITS.

cable is used throughout the entire length of the line. Under such conditions if a person listens at the telephone no sound will be heard. The reason of this is evident, for an electrical balance exists. If, however, this balance be disturbed by the coming on of a ground, say at the point *S*, the iron core of the differential coil will become magnetized by the preponderating influence of currents in one of the secondary coils. The result of these slight variations in the magnetic condition of the core will be a humming sound in the telephone. Condensers, each of a known capacity, are now plugged in at *K*. By doing this a balance is again brought about and, as it has been found that the resistance of the ground connection varies inversely as the capacity of the condensers, the insulation resistance of the circuit may be approximately estimated. In order to locate the ground, resistance in the form of "dead" arc lamps is switched in at *R* until no sound is heard in the telephone. The resistance cut in, in a case similar to the one under discussion, will equal the insulation resistance of that portion of the line which extends from the + terminal of the dynamo to the leak at *S*. The object of employing at *R* as resistance, the "dead" arc lamps of a similar make to those in service on the line, is to eliminate as much as poss ble the error which would result if no account was taken of retardation.

Foree Bain of Chicago, sold last week a 7-horse power motor to the Chicago Paper company.

Electric Motors in General Railway Work [1]

By Dr. Louis Bell.

The title of this paper makes it sufficiently evident that I do not intend to indulge in retrospection, except in so far as is necessary for illustra ion, but shall turn my attention to what is now a probability of the future.

The electric motor for street car service is an accomplished fact, as some hundreds of miles of road in daily operation bear witness. So far as practical success is concerned, the electric railroad is past the experimental stage, and is in the beginning of the commercial era. Many improvements will be made in the future, as they have been in the past, and the directions which some of the improvements have taken suggest and emphasize the probabilities I am going to discuss to-night.

First we must notice that, in a large measure, the running of single cars has been abandoned, except on small roads and heavy grades. A good proportion of electric railroads now regularly use trailers attached to their motor cars, and sometimes trains of two or more; to meet this demand for trains rather than single cars, a heavier type of motors has been introduced, and even heavier ones are being projected. A powerful motor, with a couple of trailers attached, cannot fail to suggest to the mind a possibility of a still more powerful car at the head of a procession of a coup'e of baggage cars, two or three day coaches, and as many more sleepers. Enough experiments have already been tried to show that motors nearly, or quite, as powerful as an ordinary locomotive can be readily made and handled. The power is in our hands, the possibility of using it on a grand scale seems nearer day by day, and we call up the aforesaid procession of cars to our minds' eye, and instinctively ask ourselves, why not?

Beside knowing the general properties of our present electric railroads, we are now in a position to make a fairly good estimate of their operating expenses. The best discussion of this which has yet appeared, is the recent paper of O. T. Crosby. His results are worth the careful study of any one interested in the particular study now before us, and while some of his data were necessarily imperfect, they give a very good general idea of the facts.

Some recent changes in street railway practice may prove suggestive in this connection. First, we must notice the growing use of large and powerful compound wound generators. An ordinary shunt wound machine is ill suited to railway service, on account of the very great variations in load, and consequently in voltage; nothing short of compound winding can or does keep the voltage reasonably constant, and the change is a most decided improvement. Beside this, voltage in general use has been constantly rising Less than two years ago, a well known electrician said that he did not favor the use of more than 400 volts for railway work; there are now a few roads on which from 525 to 550 volts at the station is the rule, and pressures as low as 400 volts at the station are quite the exception. This increase of voltage is probably a distinct advantage. In the early days of electric railroading, a couple of years ago, the art of insulating armature and field coil was by no means as highly developed as it is now, and I think we shall soon reach the point where the voltage used for railway work will only be limited by considerations of public safety, and only therefore when overhead circuits of bare wire are used. It is gratifying to learn that at the Kansas City convention it was agreed to adopt as far as possible a uniform standard of 500 volts for railway work. We are quite certain now that 500 volts cannot be classified as a dangerous potential, at least if the current is a continuous one; how much higher than this the limit of safety lies we do not know, though it is quite certainly below 1 000 volts. Increased voltage means increased efficiency in distribution and increased efficiency of motors if we can secure the necessary insulation. If we are ever to use powerful motors at a long distance from the generating station, the necessity of high voltage is apparent. The possib lity of using high voltages need not be questioned, for in the experiments of Deprez, and the more recent experiments at Kriegsteten, potentials from two to nearly six thousand volts were quite successfully used. The necessity for high voltage may compel us to use Gramme armatures to secure insulation, but there is no serious obstacle. Another recent important improvement in motor work is the very general use of carbon brushes, which has facilitated the operation of railway motors in a most remarkable manner. I mention these various improvements because they apply directly to the problem we are to discuss: The transmission of large amounts of power over considerable distance to fast running trains.

In looking at the possibility of handling trains with motors, two questions naturally arise before we can even consider the advisability of attempting it. First, can we readily build a motor to handle railroad trains at railroad speed? To this question, I think we can unhesitatingly answer, yes. The experiments of Mr. Daft on the New York Elevated Road make it very clear that we can build motors large enough to do the work with every hope of success. In those experiments trains of the ordinary weight for elevated work were readily handled at a speed higher than that required by schedule time. Aside from this, stationary motors of equivalent size are already in use in mining operations. In fact, with large motors, say from 50 to 150 horse power, we should expect to obtain rather greater efficiency than in the sizes more generally used. We should expect, theoretically, to obtain a rather higher weight efficiency with the larger machines. In practice very many manufacturers do not increase the weight efficiency with the size of machine. The reason for this I do not know; possibly because a machine of lower weight efficiency is sometimes cheaper to build. This question aside, there are certain advantages of a practical nature in using these large motors. When a motor becomes too large to be put under an ordinary car body, and a special motor car is constructed to hold it, it works under conditions very much more favorable to smooth and successful running, for it is far less exposed to accident and continual small troubles arising from dirt, than an ordinary street car motor. Then, too, it is possible, not being cramped for space, to arrange the whole motor outfit in such a way that it can be given close and careful attention.

The second question before mentioned is, can we rely on a motor with anywhere near the same feeling of certainty as on a locomotive? A couple of years ago we should have been compelled to answer this question in the negative, but the great and rapid improvements that have been made in insulation and the various details of construction, make one hesitate in giving that answer. We must remember that dynamos of corresponding size are in daily use, and frequently run months many hours a day, without the necessity of shutting down for any purpose whatever. Given a powerful motor, placed in a motor car, where it can have as close attention and as watchful care as any dynamo in a central station receives, and I know of no reason why it should be subject to break-downs, or require frequent repairs; to be sure, a motor is subjected to sudden and violent changes of load, but if well made to begin with and well taken care of, I do not think we should have good reason to fear its being unreliable. The case is not at all comparable with that of ordinary street car motors, which, beside lacking even a reasonable amount of care, are subject to dirt and dampness to a degree that makes it wonderful that they do not break down oftener. A motor placed in a special motor car, and properly protected, ought to run as successfully as a stationary motor, and thus unless grossly overloaded, give singularly little trouble.

Putting aside then these questions, as those can reasonably be answered in the affirmative, we come to another vital question: Can the requisite amount of power be transmitted, with a tolerable degree of economy, to the distances required? This question we are now in a position to answer. It is apparent, I think, at first sight that we cannot expect to distribute over very long distances without a frightful sacrifice of economy. The electromotive forces used are somewhat limited by the possibilities of insulation, and economy of long distance transmission can only be secured by very high electromotive forces or an enormous expenditure of copper. The immediate solution of this difficulty is to operate the line in sections of reasonable length, and this, of course, can easily be done. This at once raises the question, what is reasonable length? And to answer this question, we should have to investigate each special case in detail, for the most economical length of section would involve the relation between the loss of power in transmission over a long distance and the increased expense of shortened sections a ratio which evidently involves too many variables to admit of a general calculation.

Let me take for illustration a special case: Suppose we wish to deliver 100 horse power to a distant motor, let us assume 90 per cent. efficiency for both dynamo and motor, and we wish to transmit the power to a distance of ten miles on either side of the generating station, using a number 0 copper wire as a distributing conductor. We could deliver 100 horse power at either end of the line, with an efficiency of somewhere about 50 per cent., and we should require about twenty-four tons of copper wire for a complete metallic circuit. If the motor were moving at a uniform speed over the line we should have a gradually increasing efficiency until the motor reached the generating station, and gradually decreasing efficiency after that, until it reached the further end of the line. The efficiency as it passed the station would be 81 per cent., and the mean efficiency over the whole line consequently about 65 per cent. In this case, I have assumed, in addition, an electromotive force of 1,200 volts at the motor terminals at the end of the line, an electromotive force not at all impracticable for large motors. It is therefore clear that a twenty-mile section can be worked with a fair degree of efficiency, even using a conductor no larger than a No. 0 wire. Using a large conductor, it would be possible to work a section considerably longer. I merely mention this instance to give an approximate idea of the losses of long distance transmission and will introduce a computation for a section of more practical length later.

A question that naturally comes up in this connection is, whether it might not be possible to obtain the best results by means of a constant current motor and generator. I am aware that I am trenching here on dangerous ground, but unless the doors are locked before I close this paper, I have hopes of escaping in the melee. The mechanical difficulties of keeping a long line in order for real series transmission, are, I think, too formidable to make this aspect of the question worth discussing until they shall have been effectively disposed of for short distance work. If we were only operating, however, one motor per section of line; in other words, transforming the system into a real block system, I am not at all sure but that the constant current motor could be very successfully used, although its application to railroad work is as yet new.

A curious complication is introduced by the fact that if we were to operate a long line in sections, we should find, as the inspection of any time table will show, that on certain sections no more than one train could be running at one time, while on others several trains would have to be operated simultaneously. On these last sections larger distributing conductors would be needed, and a little study of the time table might result in a very considerable saving of copper. As the motor used would be a series motor in any case, I see no objection to working it at a constant current on one-train sections, if anything were to be saved by it.

I will now consider the power which would be required and the economy that might be obtained in an actual case, taking a single section for an illustration. The case which I am going to suppose is a transformation of the Big Four Line, from Chicago to Cincinnati, into an electric road, so far as passenger trains are concerned. The length of the line is a trifle over three hundred miles, and I shall suppose it to be divided into some ten or twelve sections, each with

[1] Read before the Chicago Electric club, March 17, 1890.

a power station at its middle point. This arrangement of the power stations evidently will secure the greater average economy. The road is a single track one, and the hypothetical section which I shall investigate is the section between Kankakee and Sheldon, Indiana, a distance of thirty miles. I take a case of this sort to show what will be the actual power required and the proximate economy, in the case of an actual railroad running its regular train on its present schedule time.

In looking over any time table it will be noticed that any such given section will only require power at certain hours of the day, and a varying amount according as one or more trains may be operated at the same time. Having worked out the times for supply power and the probable amount, I shall then investigate the probable economy of a hypothetical electrical equipment.

Looking over the time table of the Big Four Line, between Kankakee and Sheldon, it appears that passenger trains were on the section during the following hours: 10:25 A. M. to 12:35, 1:40 to 3:10, 10:25 to 1:32 P. M., and again in the early morning from 3.20 to 4:30. From 1:40 to 3:10 two trains are simultaneously upon the section; at all other times only one train would have to be operated at a time. Looking further, we should find, that by changing the time of the two local trains from Kankakee to Sheldon, which do not connect with anything, and by changing that time only a few minutes, it would never be necessary to operate more than one train on a section at a time. Making these changes, the hours of supplying power would be 10:25 A. M. to 3:10 P. M., 10:25 to 11:32 P. M., 3:20 to 4:30 A. M. The problem then resolves itself into supplying power enough to operate an ordinary train at the usual speed, and at a maximum distance of fifteen miles from the power station.

Let us now suppose the motor to work at 1500 volts at its terminals at the end of the section. The power required to operate the train would be about 200-250 horse power at the average speed, consequently the current transmitted over the line would be about 100-125 amperes.

Of course we might suppose any number of hypothetical line equipments, but I shall confine myself to one in which the amount of copper required will not be specially forbidding. I shall suppose a line wire No. 0, connected at short intervals to a bare trolley wire of silicon bronze, or some similar alloy, size No. 1 The conductivity of this system is more than equivalent to a single wire No. 000, on which I should base my calculation. I should suppose track and ground systems to be made in the ordinary way. The length of conductor on each side of the central station would be about 70,000 feet, and the fall of the potential for 100 amperes over this distance would be a little over 500 volts; the generator therefore would have to develop a little over 2,000 volts and the line efficiency at the terminals of the section would be nearly 75 per cent. The average line efficiency for the entire section would probably be somewhere nearly 85 per cent. The total amount of copper required for the section would be about 110 000 lbs, including insulation, or about 3,600 lbs. of copper per mile.

With therefore this amount of copper, which seems not at all excessive, we should have an average line efficiency of about 85 per cent., and assume for the efficiency of the motors and gears 80 per cent., which for motors running at high speed and infrequent stops, does not seem an excessive estimate. The mean commercial efficiency of the combination would be a little above 60 per cent. In other words, taking into account all sources of loss, we should probably have an efficiency of a little over 50 per cent. from the indicated horse power at the engine to the power supplied at the axles of the car.

Now let us look a little further and see the amount of power which would have to be supplied to the section which we have been considering. Looking over the time schedule we see that power is required for almost exactly seven hours, and to supply 200 horse power necessary at the train, we should have to furnish about 400 horse power indicated at the power station. We should therefore furnish 2,800 horse power hours to the section under consideration, and we should have the advantage of being able to use compound condensing engines. These engines ought to be able to furnish the indicated horse power on 2 lbs. of coal; the coal required for our supposed section then would be 6,500 lbs. for the twenty-four hours. Banking fires between runs would consume some little coal beside, but with proper engines and good firing the 2,800 horse power hours ought to be furnished on three tons of coal.

For express speeds, of course, 200 horse power would be too small and the coal consumption would be larger, while the line efficiency would be slightly lower. Still in our supposed case we could count on a mean efficiency of 50 per cent. from indicated horse power to train, for while fast trains would entail greater loss in the line, the average figure would not be seriously lowered. This amount is probably a trifle less than would be required by the locomotives doing the same work. Seven to eight lbs. of coal per car, which is a fair estimate for passenger trains, and as we may take the trains to average five cars, the amount required on the section per train would be from 1,000 to 1,200 lbs., or for the six daily trains probably 7,000 lbs. There would probably be even in this extreme case a slight saving of fuel.

We are now in a position to form a tolerably clear idea of the probable cost of equipping such a section as we have been discussing. We shall require for equipment a 400 horse power compound condensing engine, and dynamos to match, and we shall require, as before mentioned, a little less than two tons of copper per mile. In return for the investment in these items, we get an average commercial efficiency of a little over 50 per cent., and the question to be raised is the exceedingly practical one, will it pay? We gain the advantage of being able to use a very economical engine. We gain a certain number of employes who may be dispensed with. To make these gains we have contented ourselves with an efficiency of 50 per cent.

It is worth noting, too, that the mean efficiency of such a section cannot be raised to a very high figure, for the reason that even with the small amount of copper specified most of the loss is in the double transformation effected by dynamos and motors, and not in the line. If the amount of copper were doubled we should still have to be contented with a total commercial efficiency of about 60 per cent.

In Mr Sprague's very able paper before the National Electric Light association, he has pointed out the economy secured by multiplying power stations and using shorter sections. The practical way to put the question of economy to be thus secured is this: Will it pay to double the expense for power stations to save three-quarters of the outlay in copper; or will it pay to double the cost of power stations for the sake of saving the above proportion of the power lost in the line? This view is necessarily somewhat limited, for in the case of compact systems the saving can be effected without anything like doubling the cost of power stations. Without going into detailed estimate, it would seem doubtful whether there would be much practical economy in an extensive system of power stations. The three-wire system suggested by Mr. Sprague, in the same paper, is a much more practical way of securing economy, and may come into extensive use. On a double track road, such as we have in suburban or elevated roads, this three-wire system could be operated to very great advantage.

Let us now look at the locomotive a little, for the purpose of seeing whether we are going to gain enough in saving of coal and wages to pay for 40 or 50 per cent. energy lost in the various transformations of the electric system.

There seems to be a widespread popular delusion to the effect that the locomotive is an exceedingly uneconomical machine. On the contrary, the figures of actual tests show that the locomotive compares very favorably with ordinary non-condensing engines of similar size. Several locomotive tests made in New England, a few years since, gave the horse power hour on between four and five lbs. of coal, or with the evaporation of less than thirty lbs. of water. Figures obtained with the Stroog locomotive show even better results, some of the runs being made on less than four lbs. of coal per indicated horse power hour, and the average results being most remarkable.

Various foreign experiments point in the same direction, to show that a well cared for locomotive will give the horse power hour on twenty-seven to thirty pounds of water, even the small engines on the New York Elevated road, working as they do with an average horse power only 38 per cent. of the maximum, still consume only six and two-tenths lbs. of coal per horse power hour; and no engine could be put to more trying service, for nearly 16 per cent. of the power used on a round trip is used in getting up headway at stations.

As it is now, the locomotive appears to be more economical than the average non condensing single engine, but if the locomotive is ever pushed hard by any other motive power it will be developed in the direction of compounding. We have already enough tests of compound locomotives to form a pretty distinct idea of the saving that can be effected. In the series of experiments first tried in Russia, several years ago, to determine the efficiency of a compound locomotive, the average of the results obtained shows the horse power hour was obtained with the evaporation of a little less than twenty-five lbs of water. The indicated horse power ranged from 160 to 250, and the mean saving in steam over an ordinary locomotive was 20 per cent. Some of the experiments gave the horse power hour on less than twenty-three lbs. of water. Reports from compound engines tried in India are not quite so favorable, the economy in fuel being only 13 per cent. A long series of tests of the Von Borries compound locomotives in Germany gave an average economy in fuel of 16 per cent., so that on the whole, we must conclude that in the matter of efficiency the compound locomotive gives about the same results as any other compound non-condensing engine.

It would appear then that the saving of fuel effected in the electric system would practically be that due to the difference between condensing and non-condensing engines. The saving in fuel would probably be about one-half. The saving in employes would be comparatively small; two or three men would be required to operate each power station.

The margin of economy, therefore, between a long distance electric system and locomotives, appears to be just about enough to balance the losses in the transformation in the electric system. This latter, however, has two additional advantages that tend to economy. In the first place, a somewhat cheaper grade of coal can be used with a stationary engine, because better firing is possible. In the second place, an electric locomotive would have a decided advantage in the matter of weight efficiency, which insures a slight economy in power. I should say that electric locomotives of the power we have been considering, would weigh from 30 to 50 per cent. less than an ordinary locomotive with its tenders. One instinctively asks, if this lighter weight does not mean decreased tractional power? And hence does it not work to the disadvantage of the electric locomotive? This opens the question of the effect of using the rail return for the current which supplies power. Most of those who have studied the subject, think that the adhesion is somewhat greatly increased by the passage of the current from the wheel to the rail. So far as I am aware there are no experiments under anything like working conditions, which give us a definite idea of the facts. That the general opinion is well founded, I have little doubt, and in looking over some of my note books, I have found some experimental evidence. This was a fact well known, I presume, to others who have experimented on electric cars, that the ratio between the power required to start a car and that required to keep it in motion, is quite out of the proportion with the results one would expect, judging from dynamometer tests on ordinary street cars. I am of the opinion that the increase in adhesion, even under ordinary working conditions, is very considerable. Where very heavy currents are used, we know, from actual experiment, that such is the case, as has been shown by Mr. Ries.

This naturally raises the question as to the possibility of reaching very high speeds by the use of electric locomotives. Of course, in any case, increased speed means greatly increased power, and the question then becomes one of comparative weight, efficiency and adhesion; this comparison is certainly to the advantage of the electric motor, but we must remember that the limitations upon railway speeds to-day are not those set by mechanical difficulties, but considerations of safety and economy, and these do not change in any marked degree with a change in the motive power. If it would pay to run railroad trains at an average speed of a mile a minute, it would have been done long ago, and there is no reason to expect that the use of electricity would quicken the running time, unless the public demanded it and felt quite safe and reassured at the prospect of being hurled through space at the rate of 100 miles per hour or thereabouts. If there ever should be an imperative demand for very high speed I think that one may roughly estimate that the use of electricity would nearly double the speeds now in use, but the question of these very high speeds is purely a question of dollars and cents, for as a rule very fast trains are not found to pay particularly well. In the case of a suburban road, the saving in wages would be considerable, since one power station would suffice for the whole system, and the same is true, of course, of any large system operated from a single station. The Illinois Central suburban trains for example, might run electrically with great advantage to the public, and probably to the company. Smaller and more frequent trains would work wonders in the suburban traffic and the absence of smoke and dust would be a blessing to residents along the lake front.

I have been considering up to the present the sort of railroad work most unfavorable to electricity, that is, general railroad work over long distances. There are, however, certain cases in which even now electricity could be employed to a great advantage. For example, take railway lines between neighboring cities, where the passenger traffic is large and frequent trains are run. If there were two competing roads, one operated by electricity and the other by steam, I should expect at least 50 per cent. more travel on the electric road by reason of its freedom from dirt and smoke, and attendant inconveniences. The same, I think, would be true in the case of very many suburban roads, and these cases where the distances are comparatively short, I should expect lessened running expenses by the use of electricity. More especially would this be true if electric braking should ever be put into successful use; up to the present, however, it has been one of the things very beautiful in theory and attractive in experiment, but which no one has cared to attempt employing.

The case, however, where an electric system would work to the very best advantage, is the elevated railroad. In such a case we have a compact system which could be supplied from a single power station in the most direct and economical way. The damage to neighboring property would be enormously lessened, and the present objections to an elevated system would be in a great measure removed. Of the success and economy of an elevated electric system there can be no reasonable doubt, and I would go so far as to say, that in view of what can be accomplished by electricity, there is no reasonable excuse for permitting the use of ordinary locomotives on an elevated system. The question has never been properly agitated, but if it were, I can see but one possible result. The difficulties of running an elevated system by electricity are immensely less than those encountered in the operation of a great street car system, like that in Boston. In particular, the bugaboo of electric railroad men, repairs, would dwindle into insignificance; for, lifted from the dirt and mud of the street, an electric motor can readily be given such care as would reduce the repairs to a comparatively small figure.

Let us look into the gain that could be made by using electricity on an elevated line. It is, I think, a peculiarly favorable case, and we fortunately have the facts and figures at hand to determine its probable advantages. I will put aside for the moment everything except considerations of economy and running expenses, and I will turn to the New York elevated system for our facts.

The locomotives on the Manhattan railroad work under conditions anything but favorable to economy. They are on duty twenty hours per day, and of that time steam is admitted into the cylinder but six hours. The full horse power of the engine is 185, the mean horse power is said to be seventy and three-tenths; as a natural result of this, the coal consumption is high, being six and two-tenths lbs. per horse power hour. Now let us count the cost of fuel for each engine, and we shall have an average consumption of 435 lbs. of coal per hour. What coal consumption will be required to furnish seventy and three tenths horse power mechanical on an electric system of distributions? In the first place we shall have the advantage of being able to use triple expansion condensing engines, and the corresponding coal consumption is about two lbs. per horse power hour. This would mean something like fifteen lbs. of water, certainly a reasonable figure. I shall allow 125 indicated horse power to furnish the seventy and three-tenths horse power required. This certainly is a liberal estimate, meaning as it does, an efficiency of only 56 per cent. from engine to car. This allows 90 per cent. efficiency for the dynamos, 90 per cent. efficiency for the line, and a little less than 70 per cent. commercial efficiency for the motors. This estimate is surely within safe limits, for if 90 per cent. is high for the line, surely 70 is low for the large motors, for at least this figure can be secured with a good street car motor.

Against then 435 lbs. per hour of coal required for the locomotive, we have 250 lbs. of coal per hour required to furnish the same power to the train electrically. And besides, the coal required for the locomotives is of a higher grade than that which would be used with a stationary engine, for it has been found best on these small locomotives to use a rather high grade of coal, whereas I have estimated the coal consumption for the stationary engine on the basis of a cheap coal, having an evaporative power of seven to seven and one-half lbs of water per lb. of coal, and costing

less than $2.00 per ton in New York. Bearing in mind these figures, we see that the saving of coal must be considerable. The coal for the New York elevated road cost over $700,000 per year. In view of the facts I have just set forth, I think on a conservative estimate, there will be a saving of $400,000 per year by generating the power at the central station and distributing it electrically. This means lessening the operating expenses of the system by a very perceptible amount. Aside from the bare cost of fuel, the saving and handling of coal and ashes and furnishing water, will be no small item.

But even this great saving in operating expenses would not represent the saving which could be effected in operating a new elevated road by electricity. In the first place the damage to adjoining property would be enormously lessened by avoiding the noise, smoke and dirt of a locomotive. In fact, I believe that the saving in the cost of right of way would go far toward paying the expenses of equipping the road electrically. But this is not all. The use of locomotives makes necessary the use of larger train units. Larger train units mean, on the score of safety, running at rather less frequent intervals, and that in turn means giving up that as yet unrealized ideal of rapid transit, small trains running at such frequent intervals that it would never be worth while to run for one.

With lighter trains running at more frequent intervals, the strain on the supporting structure would be greatly lessened and the load more uniformly distributed, consequently the whole structure would be made light in appearance and reality, costing considerably less and being far less unsightly than those now in use.

Taking this into account it seems very probable that an electric elevated road could be built and equipped at a less cost than if it were to be operated by steam. The great ease with which small train units are handled on an electric system, should of itself be the strongest possible recommendation.

The question naturally arises, how could we equip an electric elevated road so as to secure the best results? This opens a wide field for discussion, and I can only enter it to give you my own personal views on some point which might be of advantage. Personally I do not believe in the single car as the unit of transportation. Firstly, that it increases the cost of equipment enormously, and secondly, because in running at a high speed it is inconvenient to run independent cars as close together as is necessary to secure proper accommodation. On the other hand, I do not believe in long and heavy trains. The necessary speed for the service being known, I think the general result would be obtained by using as many small trains as could be conveniently operated at the required speed. By small trains, I mean trains consisting of a motor car, and say two or three light passenger coaches. I am a firm believer in a motor car, rather than motors placed under each car, for the very practical reason that motors isolated and placed in a separate car can be given immensely better care than would ever be received by a motor hidden beneath ordinary cars. If we are to secure the minimum of repairs and the fewest possible number of break downs, I think it must be done by giving the motors steady and careful attention, and I believe this end can be reached by a separate motor car, so constructed that the motors and all the running gear can be under constant inspection. I see no objection to a composite motor car containing compartments for passengers, provided the above conditions are fulfilled, but I should hesitate to use on a system requiring high speed and very frequent trains, motors so placed that they cannot readily and immediately be reached in case of accident. As to electrical equipment, I think the problem is not particularly difficult. The size of motor to be used must be regulated by the train unit proposed. Perhaps for the unit suggested, two thirty horse power motors would answer as well as anything. It should be remembered that isolated, as the elevated tracks would be, it would be practicable and safe to use the higher potentials than is customary in ordinary street railroad practice.

The distributing conductors on an elevated system could be arranged whatever way would prove most convenient, quite irrespective of the present limitations. Neither would the amount of copper required be at all prohibitory. For example take ten miles of double track with the power station somewhere near the middle point. The wiring would of course correspond with the number of trains to be run, but working on a three wire system, with track and balance circuit the equivalent of two copper rods one inch in diameter, would serve to handle a very large equipment, and still give a high efficiency for the line. The weight of this conductor would be about sixteen tons per mile of double track, certainly not a prohibitory amount. By using two power stations this amount of copper could be reduced to one-fourth. If the amount should still seem too large another interesting possibility appears. Would it not be possible to operate an automatic block system of series distribution? By dividing the double track into sections and supplying these from one or more power stations, it would be possible to avoid most of the difficulties of series distribution without sacrificing much in the way of line efficiency. We must remember that in this connection the principle of electrical braking is easier to apply on such a system than it is on a system of distribution at a constant potential as ordinarily practiced. Electrical braking has not been put into operation in a commercial way, but some competent authorities have estimated that a saving from its use might be as great as 40 per cent. in power required. Such saving would be well worth effecting, even if it were less than the above amount, unless there should be good mechanical reasons to the contrary, and inasmuch as working upon the block system would do away with many of the objections to series traction, I think, to say the least, this line of operation is well worth careful investigation. In a great city like this, rapid transit is becoming more and more a necessity, and now before great investments have been made, is the time of all others to try to forecast the future and see to it that the rapid transit to be given the city, is the very best that modern enterprise can secure. I think we may feel sure from what has already been done, that we need have no fear of the economy of an electric elevated system, and there is no good reason therefore why it should not be tried. People do not look forward with pleasure to having a smoking, hissing locomotive spluttering by their front windows, nor do they contemplate with delight its train of cinders, ashes and grease deposited on the head of the long suffering passers by. Property owners do not enjoy the prospect of such a noisy, dirty neighbor as an elevated road operated with locomotives is even at its best, and there is no reason why they should be called upon to tolerate the abomination, when nearly all the objectionable features can be removed, not by sacrificing anything, but by gaining at almost every point.

The reform cannot be delayed; it is only a question of who will be the first to display the necessary enterprise and energy, and give this city a system of rapid transit suited to its needs, and to the age in which we live.

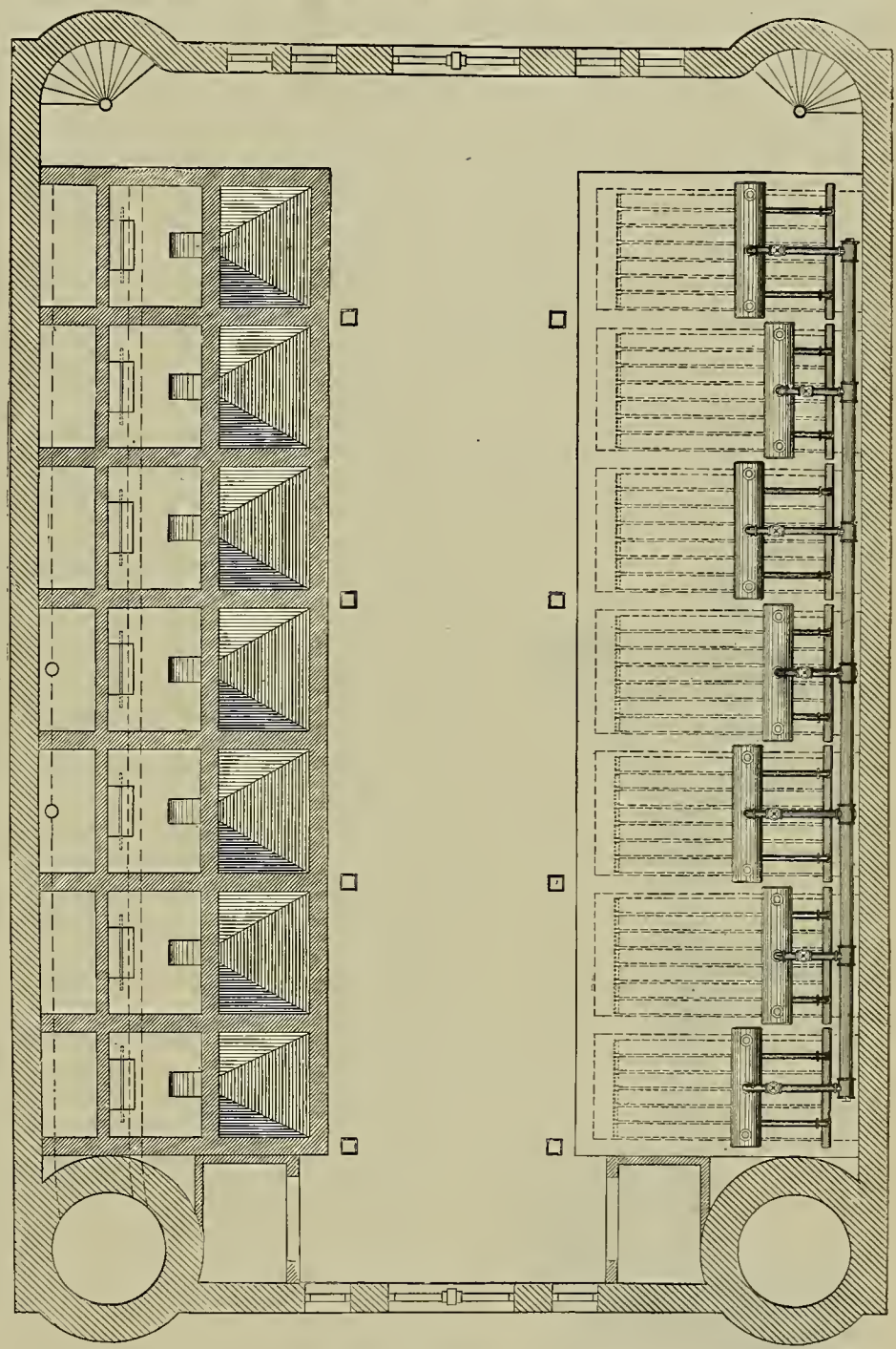
To sum up, I would state my firm conviction that the most of us will live to see electricity come into very extensive use in general railway work, certainly for special and suburban roads, possibly for long through lines.

Cincinnati Electric Railway-Telephone Suit.

In reference to a recent editorial on his article on "Electricity as Applied to Street Railways," Nelson W. Perry of Cincinnati, writes the WESTERN ELECTRICIAN: "As stated in my reply to Lieut. Sprague, I was employed by the City and Suburban Telegraph association to investigate the interference of the Mt. Auburn Electric road with the Cincinnati telephone service, and to suggest a remedy, should any be found. My conclusions were that on Mt. Auburn the McCluer device would be of no avail. By special request of the senior counsel for plaintiff, I attended the trial of the case throughout, and at its close prepared an electrical statement which was used in the oral argument, and which, at the request of Judge Taft, was included among the papers submitted for his consideration. I did not testify on the stand."

Edison Station, Philadelphia, Pa.

The accompanying cut represents the plan of the boiler room at the Edison Electric Light company's station, Philadelphia, Pa. The station is designed for 10,000-horse power, the largest in the United States. The engines are of the Armington & Sims manufacture, and it is proposed to install 20 of 500-horse power each. They are on the first floor. Directly above them are the dynamos, 40 in number. On the third floor are the boiler flues, inclosed ash track and ash pit, chutes from the floor above, blowers, blast pipes, a machine and repair shop, and storerooms. The fourth floor will contain the boilers, of which there will be an aggregate capacity of 5,000-horse power. Of these, 1,000-horse power have been installed by Abendroth & Root Manufacturing company of New York, and a second installation of 1,000-horse power is now being made.



EDISON STATION, PHILADELPHIA—PLAN OF BOILER ROOM.

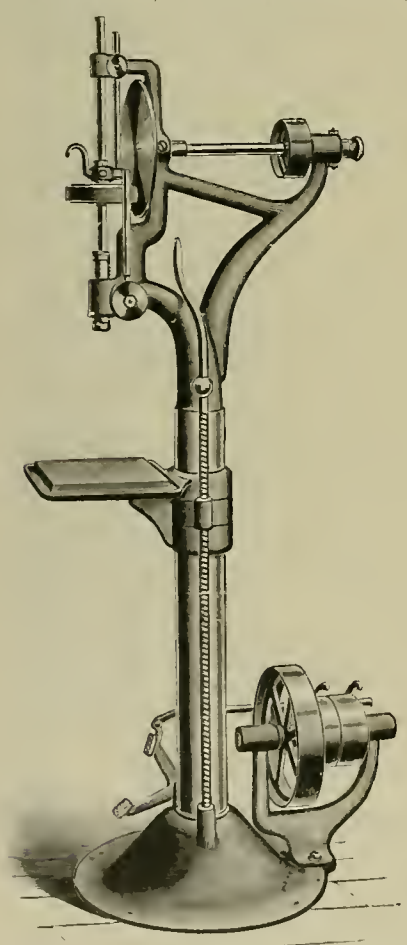
The Allegheny County Light company, Allegheny, Pa., will erect a new plant, as the present one is too small for its needs.

Death of Benj. F. Thurston.

Benjamin F. Thurston, a prominent patent lawyer, died March 14, at the University club, New York city. The deceased was senior member of the firm of Thurston, Ripley & Co., of Providence, R. I., a trustee of Brown University, by which he was graduated, a director in the Rhode Island National Bank, and chief counsel for the Providence and Western Railroad company, as well as attorney for many prominent concerns in patent litigation. His death was caused by pneumonia after an illness of but 24 hours. He had delivered a lecture at Utica a few nights previous and caught cold, but this did not deter him from appearing in court in New York city Monday to make an argument. On Tuesday he consulted a physician, and for the first time realized his danger. His wife and daughter were summoned by telegraph from Providence, and were with him at his death. The deceased was 60 years old. He was a member of the class of 1849 Harvard Law school, and from the time of his admission to the bar was eminently successful. He was an arbitrator for the Providence Tool company in the latter's controversy with the Turkish Government, growing out of the great contract for rifles, and was largely the means of getting a satisfactory adjustment of that claim. He was senior counsel for Edison in his litigation with the Westinghouse company, and occupied a prominent part in the litigation of the Bell Telephone company, and the Pullman Palace Car company.

Barnes' Sensitive Drill.

The sensitive drill, illustrated in the accompanying cut, possesses several interesting features. The tool, as is indicated in the cut, is



BARNES' SENSITIVE DRILL.

of simple construction. One important feature is that the speed of the drill spindle can be increased or diminished instantly, or the motion reversed, without stopping the machine or shifting belts. More or less driving power can be applied to the drill spindle, as the size of the drills or the nature of the work may demand. The feed lever is provided with a very sensitive adjustment which, with the perfect control of the operator over the speed and power, makes it possible to use the smallest drills, with the least possible danger of breakage. By a hand screw within convenient reach, the table can be moved rapidly on the column, and can be clamped firmly at any desired height. All bearings and wearing surfaces are especially fitted for durability, and ample provision is made for taking up wear.

On account of the variations of speed and power being so completely under the control of the workman, great effectiveness of operation is claimed by the makers.

This drill is manufactured by the W. F. & John Barnes company, Rockford, Ill.

Alternating Current Motor Tests.

The municipal authorities of Frankfort-on-the-Main, Germany, appointed some time ago a commission of experts to examine the plant and machinery proposed for the purpose of introducing the electric light. Among the questions which were considered by the experts was the general applicability of the competing systems. Concerning alternating motors, the commission made substantially the following report, which is taken from the London *Electrical Review:* In the experimental measurements of the commission a 25 and a 5 horse power Ganz & Co. alternating current motor were examined as to their degree of performance. The results were very favorable. The efficiency of the 25 horse power motor, if working up to 15—35 effective horse power, gave returns of 82 to 88 per cent., and if loaded up to 35 horse power, it still gave 85 per cent. of useful work. The small motor, with a normal load, gave 78 per cent. of efficiency, and for work of from 3 to 8 horse power, the efficiency fluctuated between 60 and 80 per cent. Hence the efficiency of the motors of Ganz & Co. falls short by a mere trifle of the efficiency at present attained by continuous current motors. In adjudicating on the competing projects this difference has no practical meaning.

The alternating current motor examined requires for starting, in addition to its introduction into the circuit, a second manipulation. The continuous current motor requires merely introduction, a displacement of the brushes being rarely needful. Of the three alternating motors examined the 25 horse power never starts automatically; the 5 and the 1-5 horse power start automatically only from certain initial positions. The manipulations needed are so simple in comparison with those required for steam and gas motors that the commission does not consider this point a disadvantage of the alternating as compared with the continuous motors.

No attempt was made to start the alternating machines when loaded, since, according to the instructions of the makers, this is generally impossible.

The continuous current motor starts in any position without help, even when loaded beyond its normal power. In this respect the continuous current motors have a considerable advantage over the alternating motors—those, at least, of the types examined.

The time required before an alternating current machine, with the driving band on, reached its normal speed, was from 30 to 40, sometimes 45 seconds.

The starting of the two larger alternating current motors was attended with a brisk production of sparks at the brushes and commutator, lasting until the speed became normal, i. e., synchronous. With the 25 horse power motor the sparks were about 1 97 inches in length, and with the 5 horse power, .79 inch to 1.18 inches. When the normal speed was reached, the length and intensity of the sparks was reduced to the slight signs which are seen at the commutators of continuous current machines with a small number of plates.

The smallest alternating current motor produced sparks in so trifling a degree that they do not need mention. This production of sparks must be considered both as regards the wear and tear of the commutator and brushes, and also as regards the danger of fire.

In the first respect the alteration is very insignificant. The metallic dust collected on starting the large motor is, on an average, each time .26 grain.

To prevent the danger of fire a sheet iron plate should be laid under the commutator.

An alternating current machine works, of course, more noisily than a continuous current machine. This noise is unimportant for manufacturing establishments and for working tram lines, but it will exclude the use of large motors in inhabited houses. The noise of small alternating current motors for the purposes of domestic industry is not great.

The alternating current motor examined is synchronous, i. e., it runs in complete accord with the primary machine at the central station.

The speed of continuous current motors depends on their load, but in good motors the fluctuations do not exceed 3-4 per cent., if the tension at the terminals is constant. Hence, in practice, there is no important difference between the two motors as regards self-regulation.

While the continuous current motor allows of the regulation of its speed by the introduction of graduated resistances, such a regulation is not possible with the synchronous intermittent current motor.

But as in permanent work with diminished speed, in most cases, stepped driving discs are brought into use, no essential difference can exist in this case between the two systems. Still, the above-named property of the continuous current motor will be of value in all cases where a transitory change of speed is desired.

For deciding the behavior of the alternating current motors of Ganz & Co., on overloading and on sudden unloading and loading, both the large and the small motor were submitted to a series of experiments.

It was first determined what maximum work the motors called by the firm of 25 horse power and 5 horse power were capable of performing. Repeated trials showed that the larger motor, if its load was gradually increased, did not cease its synchronous movement and come to a stop until it reached an effective duty of more than 40 horse power, that is, about 60 per cent. above its normal performance. Corresponding experiments on the 5 horse power motor showed that it could be worked up to 8 effective horse power, also 60 per cent. above its normal performance.

In the experiments to ascertain the behavior of the Ganz alternating motors when suddenly loaded or unloaded, care was taken that the number of rotations of the machine producing the current should remain, as far as possible, constant in all the sudden changes of load undertaken at the motor. To this end the load was once thrown upon a tertiary dynamo, driven by the secondary machine, and at another time directly upon the primary machine; the latter worked therefore approximately regularly with an unchanged load.

The following results were obtained with the 25 horse power motor:

Whilst running free, or with a load below its normal standard, any increase of load up to 26 horse power can be thrown suddenly upon the motor without affecting its synchronous movement. But if a load of more than 26 horse power is suddenly thrown upon the motor, it loses its synchronism and comes to a stand.

If the motor is working with a normal load it can bear a sudden increase of 8 horse power in addition to the 26 effective horse power, with which it was working, and then further sudden increases, making up 6 horse power, i. e., together—40 effective horse power. Any sudden loading beyond this point throws the motor out of its course, and brings it to a stop.

A sudden unloading of the motor from its maximum performance (40 horse power) down to 0, occasions no change in the course of the motor.

In the 5 horse power motor it was found that it could bear an extra load of 0 to 6 horse power, and that even in the case of the sudden addition of 9 to 10 horse power, the motor was able to run on by means of the coupling.

Management of Small Gas and Electric Light Plants.

S. J. Fowler of Westfield, Mass., read a paper on the management of small gas and electric light plants before the New England Association of Gas Engineers at its twentieth annual meeting at Boston. Mr. Fowler's experience was in connection with a gas company which purchased a small electric light plant. This was immediately enlarged, new business secured, and economy was practiced in all departments. The gas and electric light commissioners said the rates of this company were the cheapest in the state for the service. The company avoided increasing the electric business at the expense of the gas business, yet during the last eighteen months the electrical output of the station had increased 60 per cent. Speaking from his experience, Mr Fowler says: "For street lighting it is now generally admitted that arc lamps supply the popular demand for light better than anything else. We have on our streets forty-nine arc lamps and six Sims 25 candle power incandescent lamps, and our streets are illuminated to the general satisfaction of the citizens. We have no public gas lamps except fifteen on the main thoroughfare of the town, which burn from 1 A. M., when the electricity is turned off, until morning. For inside lighting arc lamps are in use in certain places, but in our small towns, where there is not a great extent of mercantile business, the cost—the necessary cost—is practically prohibitory to many of the business men, and, therefore, the arc lamp cannot be generally adopted, even if it were in all cases advisable."

Of the comparative cost of production, Mr. Fowler says: "Our experience shows the relation between the cost of furnishing electricity and of furnishing gas, to be this: The steam and labor required at the station to produce the electric current are cheaper than the coal and labor required to put an equivalent amount of gas into the holder, but in general the other expenses of manufacture and the cost of distribution, including all outside repairs under this head, are much greater in the case of electricity than in that of gas; and the expense of distributing electricity increases not according to the light supplied, but according to the possibility of supplying it to the various customers. It costs us about $14 direct, immediate outlay for each and every lamp that we put in. If a converter is fully loaded, somewhat less; but if it is but partially loaded, somewhat more. Our average is $14 inclusive of the lamp. If the wiring on private premises were not done at our expense, but at the expense of the customer, of course, the cost would be less to us, but would certainly not be less than $10 per individual lamp even in that case, and this does not include any allowance for the proportionate capital in the station and steam plant. To surely meet all charges for interest, depreciation and repairs, we assume that at least $2 per year must be allowed, therefore, it is our belief that if we cannot get enough in excess of $2 out of a lamp to more than meet our manufacturing expenses, it is not to our advantage to have that lamp on our line. We have, therefore, not endeavored to do any private house lighting by our electric department, simply because we do not see how that department could possibly make any money by it. Its income might be increased, but it would be at the expense of the capital account, which is already more than as large as we care to have it. We actually make a discount to our consumers for the electric light used during that portion of the evening when the demand would otherwise be small. We are obliged to furnish the largest quantity of electricity at a certain time and almost all the expense of the incandescent plant would be incurred if the current were to be developed only during the short time referred to, therefore, at other hours we can afford to charge our customers less per lamp-hour. This is a carrying out of the principle so familiar in the gas business of charging less for gas of day

consumption. We charge less for electric light used during the time when the mains are not fully utilized, and in this way we are enabled to compete with kerosene."

The paper advocated the adoption of fixed charges rather than meter service in small towns where the electric and gas plants were under one management. This it was said would avoid all confusion and conflict between the two departments and would remove the last vestige of competition On the discussion that followed a member said: "The people must recollect and these gentlemen who are concerned in or interested in the business must remember that it makes no difference what we do; we have got to furnish what the public calls for, and if the public demands the electric light, that demand must be met. As I said one year ago, I looked forward with anticipations of hope that the future of artificial illumination will be far advanced at the end of the next decade of years from what it is today. By one speaker this morning it was said that there is a great deal of push in these electric light men. That is exactly what I admire in those gentlemen who have control of the electric lighting interest, not only in New England, but all over the country—they are men of push, they are men of energy; and, above all, there are men of scientific attainments standing behind them who rank with any men that the world can produce. I listened on Monday evening to a paper read by one of our Massachusetts Civil Service commission, I think Mr. Lord. The electric lighting interests of Boston are taking gentlemen of that character, and are educating the public up to the benefits of electric lighting; and such a course will prove to be of great benefit to them. I will not go any further in the elucidation of electric lighting; but it is a large field. You have to meet in active competition, unless you take it into your own household. I believe, as Mr. Fowler says, that the alternating system is not antagonistic to the company, but that they work together."

CORRESPONDENCE.

New York Notes.

NEW YORK, March 15.—The acquisition of street railways throughout the country by private capital, and the converting of these roads into electric systems, is an indication that the time is not far distant when this metropolitan city will adopt electricity as a motive power on many of its street car lines. It is reported that negotiations were ended here yesterday for the purchase of the Syracuse street railways by H. Sellers McKee of Pittsburgh. The Newark deal of last week, of which it was reported that a Philadelphia syndicate had become the owner, was already the property of McKee, although the syndicate did bid for the lines. The Birmingham street railway at Pittsburgh, all the street car lines of Buffalo, as well as the extension of the electric railway at Rochester, have become the property of Mr. McKee. Mr. McKee is an enthusiast on the electric system, and will equip as far as is possible these different roads which he owns with such a system. Thus far the Thomson-Houston system has been selected by him The Buffalo and Newark contracts will be enormous, and whatever electric company obtains them will have its hands full for some time.

The General Edison company, in obtaining control of the Sprague electric railway, added to its resources in a larger proportion than its warmest friends and admirers expected. The Sprague company individually has always pursued a liberal policy, and now the combined Edison interests are reaping a large reward on the side of electric traction. The Sprague company reports so much work ahead of them that its combined forces will be taxed to the utmost for the next few months. Samuel Insull, general manager of the company, returned to-day from a short trip in Europe, and renews his personal attention in the future policy of the company.

The Western Union Telegraph company declared a regular quarterly dividend of 1¼ per cent. at a meeting of its directors yesterday. In the place of John Jacob Astor, his son, William Waldorf Astor, was elected a director. It is estimated that the net revenue of the quarter ending March 31st will be $1,550,000, the interest and sinking fund, $234,955; the dividends of $1,077,391 will leave a surplus of $237,654, which will make a total surplus for 1890 of nearly $1,000,000, or a total surplus of over $9,000,000.

The number of murderers awaiting the result of the legal controversy over the Kemmler case, is increasing. This week saw another convict added to the list. It was James J. Slocum, who murdered his wife Dec. 31. This is the fifth conviction since the electrical execution law went into effect in this state.

Lenox Lyceum, which has been the favorite place for social gatheriogs during the winter, has been leased by the Woman's Exchange for an extended exhibition partaking of an electrical nature. Mr. Edison has been a hearty supporter of the society. His contributions of money in the past have been supplemented by an offering of his entire Paris exhibition for the present display. This is the private exhibition of his inventions which created so much comment among the Europeans and Americans who were fortunate enough to attend the Paris exposition. The Bell Telephone company has placed at the disposal of the exchange all its latest inventions, and the Phonograph company has done the same. Another feature of the exhibition, which will be entirely novel, is a glimpse of the twentieth century, a la Bellamy. This has not been completed yet, but will of necessity be electrical in its character.

The legislature of the state of New York has refused to revoke the provision in the electrical execution law prohibiting the publication of the particulars of the execution. One of the leading newspapers commenting on this action of the legislature, says: "There is nothing left for the press but to secure its reports of executions in this state as best it can. The presence of reporters at executions would insure accurate and prompt records. The law may deny the right of the press to be represented at these solitary sacrifices, but it cannot prevent this newspaper from printing reports of the same. And we will guarantee that they will be pretty good history."

A new company has been incorporated at Boston for the manufacture of an insulating material, the test of which as to electrical resistance is said to be remarkable. The company propose to manufacture tubing for interior work at a low price. The organization is known as the Laminar Fiber Goods company. The officers are: Henry H. Rueter, president; H. A. Rueter, treasurer; T. S. Hanna, superintendent of the factory at North Cambridge, and C. H. Whall, manager. Several prominent New York capitalists are interested in the new company, among whom is Henry Clansen, Jr. W. H. T.

Cincinnati.

CINCINNATI, March 15.—Electrical matters in Cincinnati have been very lively for the past several months. The injunction suits between the different companies, the building of large central stations by the Cincinnati Electric Light company and the new Thomson-Houston company have attracted a good deal of attention. Both of these stations will be models of their kind, and when they are put in operation Cincinnati will be one of the best lighted cities in the country.

The Card Electric Motor & Dynamo company has recently been incorporated and will succeed to the business of the Geo. F. Card Manufacturing company. The company is located at the corner of Front and Johns streets, and will push the sale of their goods with all dispatch. H. H. Walters is the manager of the new company.

Chas. Hill has sold his entire interest in the Hill Electric works to Chas. E. and H. G. Francis and John A. Smith. They are moving their factory to a large and commodious building on North Eighth street, where they will manufacture a number of special types of motors.

Wm. Powell, of the Wm. Powell company, who has been confined to his house for almost two months past by la grippe, has about recovered and is able to be at his office.

The Jones Bros. Electric company is extending the facilities of its lighting station on Court street, and has recently added two Mather dynamos of 600 lights each, with all necessary attachments, which are to be operated by a Beck 100-horse power high speed engine, especially designed for this class of work. D.

Kansas City.

KANSAS CITY, MO., March 15.—Messrs. S. M. Jarvis and R. R. Conklin have just returned from a business trip to Augusta, Ga., and a general tour throughout the South. One of the principal objects of their visit was business in connection with an electric railway company which has just been organized in the city of Augusta. Colonel D. B. Dyer, a well known Kansas City man, has been in Augusta for several months, and has strongly favored the investment of Kansas City capital in an electric road at that city. W. B. Knight accompanied Messrs. Jarvis and Conklin to the South as civil engineer, to look over the ground with them. The result of the visit was that a railway company was organized with Colonel Dyer as president. The two existing roads in the city were bought out and arrangements completed for building an additional fifteen miles of double track road. The company is organized under the name of the Augusta Railway company. Mr. Knight has gone on to New York to make arrangements for electrical supplies. The gentlemen who have returned are enthusiastic over the new South, and say the Southern boom has just begun.

The Noiseless Auriphone company has filed articles of incorporation. The object of the company is to manufacture, sell and lease earphones for telephones. The capital stock is fixed at $100,000. The incorporators are A. M. Sloss, Max Weil and Julius J. Wollf.

M. D. Wood, manager of the Western Union telegraph office in this city, has been connected with the office here since the spring of 1866. He was then the only operator, and E. B. McDill was the manager. Both were operators and alternated in receiving the night press dispatches, which amounted to between 4,000 and 5,000 words a night. During the first year that Mr. Wood was in the office he frequently did the entire work, from 7 A. M. until 1 A. M., for a week at a time, when Mr. McDill was sick. In 1870 Mr. Wood was made manager of the office, and has held it ever since It now requires 217 persons to do the business which he once did alone, and the Associated Press dispatches are received in another office.

Kansas City now stands fifth among cities in the amount of Western Union telegraph business handled, and seventh in amount of receipts. During the past year the receipts have increased about $13,000. Over 6¼ million messages were handled, over 1¼ million being city messages received and sent and the other 5 million being relays and press special dispatches. To transact this business there are 154 operators, 50 of whom are women; 39 messengers, 23 clerks and a manager. This great volume of business comes into the office over 120 separate wires, and 54 loops extending to city offices aided in facilitating it. Kansas City is one of the greatest relay offices in the country More than three times as many messages are relayed here as are received and sent for the city proper.

In no year since its establishment in this city has the Postal Telegraph done as much work in extending its lines westward as in the past twelve months. Lines are being built throughout Kansas. Denver will be connected by April 1. With this connection by northwestern wires the company will reach from the Atlantic to the Pacific. At Topeka it gets a Texas connection to the gulf. From the main line the company intends to reach all towns of importance west of this point. The company reports an increase of 25 per cent. over last year's business. Fifteen more operators are employed in the main office than a year ago.

The stockholders of the Kansas City and Blue Valley Railway company held an important meeting last week, at which they decided to begin work immediately on the road. It is to be an electric line. The company is made up of men who will make it a first-class road from the start. The directors are T. J. Green, L. E. Davison, Morrison Munford, S. P. Twiss and O. H. Queale. The officers are T. J. Green, president; L. E. Davison, vice-president, and O. H. Queale, secretary and treasurer. The road, which will be six miles in length, will be double tracked throughout, and will be built in first-class style. It has not been decided yet what system will be used. The franchise requires that the road shall be completed in six months, but it is proposed by the company to complete it in ninety days. The country through which the new electric road will run is a high beautiful residence portion of the city, and it will also bring the manufacturing districts within a short ride of the city.

Incorporation papers have been filed for the Galena Electric Power & Mining company, to be located at Galena, Kan. The directors for the first year are William B. Stone of Galena, A. W. Walburn of Fort Scott, Charles E. Hart of Baxter Springs, Arthur E. Stilwell, Delbert J. Haff, Ira C. Hubbell and Charles S. Rustling of Kansas City. The capital stock is fixed at $200 000, and all is paid in. The company proposes to locate a motor in front of each mine and operate its machinery by electric power. They will also establish an arc light system in Galena. The Thomson-Houston company is back of the concern. Galena is an enterprising, wide-awake coal-mining town of 2,000 or 3,000 inhabitants in the southern part of Kansas. W. B. Stone, one of the directors of the new company, is a wealthy mine owner, and it is for his mines more than any others that the company was formed.

T. F. Clohesy, electrical engineer, has been asked to read a paper at the forthcoming convention of the Western Association of Insurance men, to be held at Excelsior Springs, March 18, 19 and 20. The subject will be "Insurance Companies and Electric Light Interests."

A meeting of Seventeenth street property owners, who object to the proposed electric line on that street, was held last week. The objecting property owners are confident that they will defeat the proposed electric line franchise.

At the next meeting of the Electrical club of Kansas City, T. F. Clohesy will introduce a resolution to the effect that the city school teachers and high school pupils who take an active interest in electricity be invited to attend any and all meetings of the club.

Chief Hale and Elbert Barrett have just perfected an improvement on the Hale fire alarm system. The chief has a number of machines arranged around the walls of the third floor of the fire department building. Boxes provided with a police and fire alarm to be placed at different points are connected with police headquarters and the fire department. The doors of these boxes are locked, but in case of an emergency a glass in the door may be broken, and the alarm turned in. In addition to a tele-

phone at the department headquarters there is a telegraphic register which, noting the number of the box turning in the alarm, and in case the telephone does not work, the location can be definitely determined.

The first round trip over the Northeast Electric railway was successfully made this week, and the road was found to be in excellent condition for regular travel. A score of the officers of the road and their friends met at the power-house of the line, Lexington and Prospect avenues, and all united in expressing gratification at the equipment of the road and the excellent facilities for the transportation of passengers. In the engine-room five large dynamos, representing a combined capacity of over 500 horse power, have been installed. Two 300 horse power Babcock & Wilcox boilers furnish steam power. The equipment is more than enough for any possible emergency, with sufficient reserve. Five cars are running, and others will be put on as fast as received from the factory. The road will make transfers with the Metropolitan system without extra charge. An officer of the line stated that $250,000 has been expended in the enterprise since last summer. It is the intention of the management to make it one of the best equipped electric lines in the United States. A building 100 by 50 feet in size will be constructed near the power house to be used as the general office of the company. Work will be commenced at once upon the structure. The road extends three and a third miles from Market square in a northeast direction beyond the Porter road. The officers of the line are: W. H. Winants, president; E. A. Phillips, vice-president and general manager; W. C. Scarritt, secretary; S. C Clark, superintendent; J. W. Ripley, auditor, and M. E. Bates, electrician. The new electric line cannot fail to prove an important factor in the development of the territory through which it passes

There is abundant reason to believe that Kansas City will soon have one of the largest and best equipped electric roads in the country. A company is now being organized to build an electric road from Kansas City to Independence, and it is intimated that a good share of the stock will be held by Eastern capitalists who have become interested in the enterprise through the representation of delegates to the recent convention of electric light men. It is stated by those who have been given an outline of the project, that the line will be twenty miles in length and will cost, including equipments and right of way, almost $1,000,000. The Sprague system will be used. If the present plans are carried out the company will construct a belt line, but the route has not been positively decided upon.

Colonel R. C. Clowry, vice-president and general superintendent of the Western Union Telegraph company, was in Kansas City last week. He stated to the WESTERN ELECTRICIAN correspondent, that the company was contemplating the removal of its local office from the present location on Fifth street to some building further up town.

He was asked concerning his company's policy on the subway ordinance now before the council, but on the question as to whether it would comply with its terms, he was silent. He complained of the interference of the electric light wires with telegraph wires, and thought that the high tension wires at least should go underground. Colonel Clowry expressed much satisfaction with the experiments with the new system of transmitting electric currents by substituting dynamos for the battery system.

The city council of Kansas City, Kan., by a unanimous vote passed an ordinance granting to Norton Thayer of this city and T. J. Enright, the big contractor of Argentine, a franchise to construct and operate an electric street railway, beginning at the northern city limits and running through the central portion of the city, and over the new Union Pacific viaduct to Argentine. The ordinance was one of the most important measures ever passed upon by that body, inasmuch as it will tend to bind together the North and South side districts. The ordinance provides that the company shall begin work within three months and have the line completed and put in operation within a period of fifteen months. The company will also be required to put up a cash bond of $5,000 to insure the completion of the road within the time specified in the ordinance. Mr. Enright stated that, although the franchise was the most stringent one ever passed by the council, it would be accepted by the company and work would be begun on the construction of the line as soon as the weather would permit. P.

Boston, Mass.

BOSTON, March 15.—The most important local event of the past week to Boston electrical men was the dinner of the Electrical club at Young's Hotel on Monday night. It was a notable gathering of the club members and their friends, over one hundred being present to partake of the dinner, over twenty-five of these being guests. Five state senators and seven representatives were among those who partook of the hospitality of the club and listened to the after dinner discussion on the subject of the "Transmission of Electrical Energy." The discussion was opened by Prof. Elihu Thomson, who treated the question in a simple and practical way, speaking of some of the fundamental principles, the rapid development of the industry, the special and more extended applications of electric power, pointing out the possible dangers and risks in the transmission of electric energy, and indicating the lines along which progress will be made in the future. He said it was possible that in ten or fifteen years we might hear of 1,500 or 2,000 horse power electric generators in as general use as those at 100 horse power are now, and expressed a hope of some day seeing electric railways taking the place of steam roads entirely, and all small and isolated steam engines superseded by electric motors. Thomas D. Lockwood spoke of the transmission of power as exemplified in the telephone system and of the need of certain legislative restrictions in the handling of the electric current, believing that legislation in this matter should be in the hands of the state instead of being left to local bodies. Capt. Eugene Griffin of the railway department of the Thomson-Houston Electric company, made a brief speech upon the electric car system of Boston and advocated a high rate of speed on the surface roads. President Cram called the attention of the legislators to the fact that many of the past evils in electrical matters could be avoided if the legislature would depend upon practical electricians for information when they were called upon to frame laws. A. L. Rohrer, one of the club's vice-presidents and the chairman of the house and entertainment committee, was the presiding officer of the evening.

Governor Brackett recently was invited to deliver an address at a meeting of the Mutual Building Loan association to be held in Cooper Union, in New York, last night. Finding that he could not comply with the request, he went to the office of the New England Phonograph company in this city, and delivered his address before the phonograph. The phonograph cylinder was then transmitted to the chairman of the meeting to be used in reproducing the speech of the governor at the meeting.

The Bell Telephone company has declared a regular quarterly dividend of 3 per cent. to be paid April 15 to stockholders of record March 31. The books will be opened April 16.

The financial columns of the *Herald* yesterday said. "We are informed that important patents have just been allowed by the United States patent office to the Thomson Electric Welding company. These patents promise to be of great value to the company and may cause the early organization of a subordinate company, paying tribute to stockholders of the Electric Welding company."

Col. E. H. Hewins is announced to lecture on Thursday evening, March 27, before the Society of Arts at the Massachusetts Institute of Technology on the "Application of Storage Batteries to Street Car Propulsion."

The Boston Electric Light company, through its treasurer, Mr. Sias, has petitioned the board of aldermen for the right to locate eighty additional electric light poles in the Jamaica Plain district of the city.

The Shawmut avenue line of electric cars in this city is now provided with platform gates on the inner side, next the other track, to prevent persons from leaving the car upon the dangerous side.

At the State House this week the committee on manufactures has had two more continued hearings upon the petition to give cities and towns the authority to manufacture and furnish gas and electricity. The Nationalists are advocating the scheme and supporting the measure before the committee. Closing arguments will be made in remonstrance next week by Hon. John C. Crosby and Mr. E. W. Burdette, representing the Massachusetts Electric Lighting association. Some interesting arguments are expected.

The committee on street railways of the legislature this week gave a hearing on the petition of R. T. White of 12 Pearl street, Boston, for an elevated railway charter in the streets of Boston. Paul West appeared as Mr. White's counsel, and Mr. White exhibited drawings and models to illustrate his system. Mr. White has become well known among street railway men through his devices for roadbeds of street railway tracks.

The various schemes for elevated railways in Boston are being presented to the street railway committee of the legislature by their several advocates. The West End Street Railway company had its turn recently, and its case was ably presented by President Henry M. Whitney. It proposes to unite an elevated track with its present system of surface tracks, the two to be joined by an inclined plane, the ordinary cars now in use being thus transferred from one system to the other. The track would be elevated only in the most crowded streets in the business portion of the city, probably on Washington and Tremont streets only.

A new electric lighting project for the Back Bay district of Boston was recently made public. It is one that is likely to meet with as much hostility from the companies now in business as the Suburban company experienced. The new company is to be known as the Back Bay Incandescent Light company, and will, if its proposal is carried out, establish a plant on the water front with a capacity of 10,000 lights and all wires will be put underground. The project is backed by such men as Ex-governor Oliver Ames, Fred M. Ames, John A. Pray, and many others. At the organization meeting Samuel N. Aldrich was elected president and Stephen M. Crosby, treasurer, and a board of directors was chosen consisting of twelve of Boston's most influential and wealthiest men.

The West End company has notified the Thomson-Houston company that it will hereafter do its own railway construction. This has reference merely to the line work on trolley wires, feed wires, spans, pull offs, guard wires, etc. The pole setting has always been done by the West End company. The Thomson-Houston company will continue to equip cars and operate them. The *Herald* in its financial columns says that the West End company was to pay the Thomson-Houston company a graduated rate per car mile for repairs and maintenance, beginning at 2½ cents and running down to 1½ cents in the case of single motor cars. It is now less than 2 cents per car mile, and amounts in the aggregate to about $6,000 per month. For double motor cars the rate is higher and for two cars less. It also says that the cost to the Thomson-Houston company for material for such repairs in a recent cited instance for one month was 10 per cent. less than 1 cent per car mile.

A party of twenty or more, composed of the city officials of Providence and the managers of the horse railroads in that city, came to Boston on Wednesday of this week, to examine into the working of the electric railways here, and were favored with a special car by the West End company in which they made a trip over the Brighton line to Allston and there inspected the power plant. The city officials of Brooklyn, N. Y., recently examined the system in a similar manner, and were highly pleased with the remarkable success attained. O. H. M.

THE ELECTRIC LIGHT.

A company has been organized at Attala, Ala., to establish an electric light plant.

The Clifton Forge, Va., Electric Light & Power company has been incorporated.

The Natchez, Md., Gas company is installing a new engine for its electric light plant.

The Louisville, Ky., Electric Light company has added an incandescent dynamo to its plant.

The Fort Smith Gaslight company of Fort Smith, Ark., has purchased a Thomson-Houston 35 light arc plant.

The Auburn Mining company of Auburn, Ind., will install a 300 light alternating plant of the Thomson-Houston system.

Yorkville, S. C., contemplates the erection of a city electric light plant, and the mayor, J. F. Hart, is investigating the matter.

The town council of Columbia, Ala., has appointed a committee to investigate the cost of an electric light plant for the city.

A petition has been presented to the city council of Newport, Ark., for a franchise for an electric light plant for twenty years.

It is probable that a company will be formed at Yorkville, S. C., soon, to erect a Westinghouse central station for an alternating system.

A Thomson-Houston 650 light alternating machine has been added to the capacity of the Boulder Electric Light company, Boulder, Colo.

The installations of the Pacific Electrical Storage company, San Francisco, during the last year for electric lighting, aggregated 266 lamps.

The Capitol Gas company, Sacramento, Cal., has increased its capacity by adding a 50 light arc machine of the Thomson-Houston system.

J. A. Bendure of Ottawa, Kan., has leased the electric light plant at Pittsburg, Kan., for five years. He will make many improvements in the service.

The new owners of the Tampa, Fla., electric light and power plant will enlarge it immediately. Additional arc and incandescent machines will be installed.

John Featherstone & Sons have contracted with the Thomson-Houston Electric company for a 20 arc-light plant, to be installed in their iron foundry at Chicago.

The Thomson-Houston Electric company, through its agent at Salt Lake City, has closed a contract with the Osceola Gravel Mining company, Osceola, Neb., for an arc-light plant.

The movement to secure a city electric light plant at Milwaukee appears to be gaining popularity, though it is opposed by the organized companies of course, which have invested large sums of money installing a plant for street

lighting. This plant will lose much of its value and have to be changed if the street lighting is conducted by the city in the proposed manner.

The Faribault, Minn , Consolidated Gas & Electric Light company's station was destroyed by fire recently. The damage is estimated at $10,000. The origin of the fire is unknown.

The Edison Electric Light company of Rochester, N. Y., will build a new power house, 40x175 feet, and two stories in height. It will be a brick structure and will cost $35,000. It is expected to be ready for occupancy May 1.

The Westinghouse Electric company has been awarded the contract to furnish an alternating current central station plant, with its apparatus, for Methuen, Mass. The station will have a capacity of 750 incandescent and 45 arc lights.

The Incandescent Gaslight & Oil Lamp Manufacturing company at La Grange, Ill., has been incorporated to manufacture lamps and burners, etc.; capital stock, $100,000; incorporators, A. G. Morey, C. E. Thornton, and F. E. Morey.

The English syndicate has closed with the United Gas Improvement company of Philadelphia and the gas plants controlled by that company will immediately be transferred. The syndicate proposes to establish electric plants in connection with the gas plants.

The following new Heisler plants have just been started. Holden Water company, Holden, Mo.; Bonham Electric Light & Power Company, Bonham, Texas; H. H Williams & Co., Wauseon, Ohio. At Holden and Wauseon these plants are doing the city lighting

The first central station electric lighting plant on the alternating current system for Japan is about to be established. A corporation of Japanese capitalists in Tokio has awarded the contract for the apparatus to Westinghouse Electric company of Pittsburg, Penn., and the machinery consisting of two 750-light dynamos, as well as exciters, lamps, sockets, switches, cut-outs, etc., will be shipped immediately. The company which purchases this outfit is also engaged in the installation of a lighting plant for the city of Canton, China.

The Chicago Edison company has just finished wiring the New Metropolitan Block, Michigan avenue, corner Monroe street, Chicago, for 400 lights. Current will be supplied from the central station. The second and third floors of the Rand & McNally building, on Adams street, which will be occupied by the Chicago, Milwaukee & St. Paul Railroad company for offices, will be lighted by 500 incandescent lamps, the current for which will be supplied from the Edison mains. The Chicago Edison company has finished wiring the offices.

One of the earliest Heisler electric light plants was installed for the Leavenworth Kan. Coal company. For some years the company has been operating two large Heisler machines, and have just added a third. A short time ago the Tampa Fla. Electrical Illuminating company, ordered an outfit, and before starting up, found such a demand for lights that they placed an order for additional apparatus, doubling the original capacity. The company operating a Heisler plant at Orange, N. J., has also found it necessary to add another large machine.

An excellent testimonial to the superiority of electric lighting from a point of safety, is given in a circular issued by the Boston Manufacturers' Mutual Fire Insurance company, which says: "Since April 1, 1882, a period of nearly eight years, we have received no notice of any fire which could be attributed to electricity in any risk insured by this company. * * Our experience, therefore, justifies the conclusion to which we came after the first two years of electric lighting—that under proper safeguards it is the safest method of lighting that can be introduced."

The Heisler Electric Light company of St. Louis receotly forwarded two car loads of electrical apparatus, including dynamos, regulators, sockets, lamps, street and indoor fixtures, wire, insulators, pins, etc., etc., for the complete installation of Heisler long distance incandescent plants in the cities of Durango and Aguas Calientes, Mexico. Both of these cities are to be lighted exclusively by the Heisler system, and sufficient dynamo capacity will be provided for a large amount of commercial lighting. It is expected that these plants will be in operation by May 1. On account of the high cost of fuel, compound condensiog high speed engines are being used.

The National Meter company and O. Tirrill of New York, have recently effected a combination of interest to those persons who use gas machines. The combination consists in a Tirrill equalizing gas machine, a Nash gas engine and a Perret dynamo. The arrangement is automatic from first to last, the light is much steadier than gas, to say nothing of its other advantages. The dynamo used is the Perret automatic compound machine, the efficiency of which could not be better illustrated than by its many recent combinations with small engines of this kind, where the power supplied is very limited as compared with the results to be attained. A 25-light plant of this description is now in successful operation at 39 Dey street, New York. The installation is of special interest to persons living in the country who use gas machines.

Eugene Field of Chicago, who is enjoying a protracted visit to London, finds many disadvantages in living in the English capital. He says the people of that city still stick to many old customs which have been forgotten in this country. In a recent letter he says: "Candles are going out and gas is rapidly gaining in popularity as an artificial light; there is talk of introducing the electric light, and wires have been put down in parts of London, but the fight in certain quarters against the introduction of the electric light is conducted with so great obstinacy and with such method as to induce the suspicion that a conspiracy is afoot. The local press seizes upon every opportunity to advertise and dilate upon every petty casualty that is reported from America as a penalty of the electric light system. Even the London edition of the New York *Herald* lends its columns to the promotion of the silly heresy, yet in the home office of the New York *Herald* the electric light has been in use so long as to have come to be regarded as a necessity. So far as electrical plants are concerned Edison practically has the field to himself. The agent of another patent was telling me last week that since Edison's visit to Europe it seemed quite impossible to get anybody to examine any system but Edison's. With his ingenious talking machines and showy devices the shrewd wizard of Menlo Park appears to have captured the native population, from royalty down to cockney."

THE ELECTRIC MOTOR.

The Galena, Kan., Electric Power & Mining company has been incorporated with a capital stock of $200,000, to establish an arc light system in Galena, and operate mining machinery by electric power; incorporators, William B. Stone, of Galena; A. W. Walburn, of Fort Scott; Charles E. Hart, of Baxter Springs; Arthur E. Stillwell, Delbert J. Haff, Ira C. Hubbell and Charles S. Rusling, of Kansas City.

Thomas Lowry on his return to Minneapolis from his eastern trip, reported that the statement that he was desirous of selling the railroads in the Twin Cities, which he control was without foundation. On the contrary, he said he had purchased additional stock while in New York. He said he had investigated the claims of the Sprague company and was well pleased with the workings of all the roads he had seen operated under that system.

Frank B. Rae of the Detroit Elecirical works, has gone to Fort Worth, Texas, to superintend the work of extending the electric street car service there. The Fort Worth road is now equipped with nine cars of the Rae system, which are running regularly and six more cars are to be added immediately. The road has about fifteen miles of track. The Rae system has just been put in use at Saginaw, Mich. Twelve cars are now running on that road and eight more are soon to be put in use. This road has seventeen miles of track.

A Covington, Ky., correspondent writes: The legislature emphatically rebuked the high handed attempt that was made to deprive the Street Railway company of this city of the right to use electricity as its motive power. The bill introduced for that purpose is defeated by the unanimous recommendation of the special committee to which it was referred, and the unanimous vote of the senate. It is creditable to that body that it so promptly and effectually disposed of this unrighteous and unfair legislation, and its course has the hearty approval of the business men and citizens of Covington. It insures that there will be no delay or obstruction in the securing of rapid transit for all parts of the city; and especially its assurance to outside business men and capitalists who invest their money in the development of Covington's interest that they can rely on fair and equitable treatment from the city and state. This assurance seemed necessary, but it comes in a way that leaves no doubt for the future.

The report of East Readiog, Pa., Electric Railway & Motor company for the year 1889, emphasizes the fact that electric railways are a commercial success, and that even during the first year of their operation, they show gratifying financial results. This road was installed a little more than a year ago, upon the Sprague electric system, and although its location is not particularly advantageous, the results have been extremely gratifying. The number of cars equipped is four, and the annual report of the treasurer issued on the 1st of January, shows that dividends at the rate of 8 per cent. per annum upon the working capital were paid, besides leaving a large balance in the treasury. Another interesting fact in connection with this report is that it shows that during the last year the number of passengers carried was more than double the entire population of Reading. Nothing can more convincingly show the popularity of electric railway motor power. The operating expenses during that time were $4,380.81.

When electric railways were first introduced, it was believed by street railway men that the motors were not sufficiently durable for street car service. This cannot be said of the motor of to-day, as is aptly illustrated in the operation of electric cars upon the line of the Erie Electric Motor company. One motor car on this line has run 19,300 miles without requiring repairs of any kind. A second car, equipped with only a single motor, has run 15,000 miles without repairs being required, and other cars have records very nearly as large. When the arduous work required of these street railway motors is taken into consideration, this is truly a remarkable record, and one which is most gratifying to all interested in electric traction. The Erie electric railway has been in operation for a number of months on the Sprague electric system, and is said to be giving satisfaction to the managers of the road, and to the general public. The equipment of the road is complete in every respect. At the station the power plant includes two 150-horse power Ball engines with 16 in. x 16 in. cylinders, each engine to be belted directly to two 50,000 watt railway dynamos which furnish the current to the line. The motor car equipment consists of fifteen electric cars, equipped with the Sprague improved motors and all the latest atttachments and devices used by the Sprague company upon its cars. When the installation of this electric line was proposed, there was considerable opposition from property owners along the route who were not acquainted with electric railway systems. The road has become very popular, however, on account of the rapid transit facilities afforded, and has carried large numbers of passengers since it has been in operation.

THE TELEGRAPH.

The Chicago Board of Trade made another move recently to take the tickers out of the bucket shops of that city, but the motion of the board's attorney to set aside the injunction secured by the bucket shops, was denied.

The St. Louis papers claim that another "fake" school of telegraphy was started in that city by E. Bailey Roeth, and the labor commissioner of the State is now investigating the charges preferred by alleged victims. The usual inducements were offered to all who should join the class, but the members now claim Mr. Roeth failed to keep his agreement.

Postal telegraph bills are accumulating in the House of Representatives and Postmaster General Wanamaker may find it impossible to secure any one to support his measure now before the committee. The latest bidder for popular favor in this line is Representative Taylor of Illinois who introduced his bill last week. It provides that the "Board consisting of the secretary of state, Secretary of War, and the postmaster general, shall cause to be built or shall buy lines of telegraph where, in its opinion, such are needful. It shall be the purpose of the government that these Government telegraphs shall yield no earnings, beyond the cost of operating the same, and at all times to keep the outgo and income as nearly equal as may be. To this end, as soon as may be, the postmaster general shall name such rates at which messages may be sent as shall keep the total earnings and expenses as nearly equal as may be, or as shall make the lines self-sustaining, and the postmaster-General shall from time to time so change the rates that they shall comform to this requiremen'. It is provided further that until it shall be known what rates must be charged in order to carry out the above requirement, the rates shall be as follows: All government telegrams or private telegrams sent over a single circuit or unbroken line of telegraph without relay, and requiring but one operator at either end, without regard to distance, one cent for each word, counting the address and signature, but not the date; but no telegram so sent shall cost less than 15 cents. For each additional circuit or relay requiring an additional dispatcher and an additional receiver, an additional charge equal to the charge for sending the same message over one circuit without relay should be made."

The New York *World* disapproves the scheme proposed by the postmaster general in a strong editorial from which the following is an extract: "The proposal of the postmaster general to establish a Postal Telegraph system is in many respects a seductive one. But there are objections of the gravest character to the taking of any step in the direction of state socialism. The chief of them is that the tendency in the direction of that form of despotism is already much too strong to be comtemplated with equanimity by lovers of democratic liberty under a state with restrictive functions. The Postal telegraph might easily develop into a government monopoly of telegraphs to be followed in natural course by a government monopoly of railroads, express lines, mines, factories, and the like. That way danger lies. Apart from these dangers there is the immediate objection that the institution of government telegraphs in any form must involve a great increase in the number of government officers and employes, whose number is already a source of embarrassment and a cause of corruption. It is also to be borne in mind that under a Postal Telegraph system the people opposed to the party in power must be in effect shut out of the privilege enjoyed by their antagonists of communicating with each other on political matters by telegraph. It has never been deemed salutary to give so great an advantage as that to the possessor of power."

Personal Mention.

A A. Anderson has sent to the Paris salon a portrait of Mr. Edison perfecting the phonograph.

T. C. Hughes of Kansas City, was an interested visitor at the Chicago Electric club meeting Monday evening.

F. S. Schallnberger of Pittsburg, and Geo. B. Prescott, Jr. of New York, recently visited Chicago.

The following named gentlemen visited the Chicago Electric club last week: W. J. Lloyd, Chicago; S. H. Klinger, St. Louis; Jas. A. Lounsbury, Chicago; Theo. C. Ives, New York; R. I. Sloan, New York.

Miscellaneous Notes.

Foree Bain of Chicago, is building a dynamo of a capacity of 3,000 amperes and from 6 to 8 volts, for Winslow Bros., of Chicago. The machine is to be used for electroplating.

The Manufacturers' club, Philadelphia, is one of the most magnificent club houses in the world. The building is fitted with the most approved electrical appliances and the isolated plant of the United States company furnishes 650 incandescent lamps with current. The Allen-Porter engine is a model in its way, and the entire system is a most satisfactory arrangement. The club publishes a journal fortnightly called the *Manufacturer*, whose influence is being widely felt in extending the social and commercial interests of Philadelphia's leading organization.

Among the remarkable examples of bold engineering in the great sugar refinery of Claus Spreckels, at Philadelphia, Pa., one of the most unique is the hanging or aerial steam engine foundations. The engines used in this establishment are distributed practically all over the buildings, a large proportion of them being on upper floors. Some of these engines are bolted to iron beams or girders on second and third stories of the building, and are consequently innocent of all foundation. Some of these engines run noiselessly and satisfactorily, while others produced more or less vibration and rattle. To correct the latter, the engineers simply suspended foundations from the bottoms of the engines, so that, in looking at them from the lower

floors, they were literally hanging in the air. A foundation does service to an engine, or any machinery, it seems, by its weight alone; hence, it makes little difference whether the foundation be firmly embedded in mother earth or in the air.

Business Mention.

The Eclipse Wind Engine company, of Beloit, Wis., has just completed waterworks for the city of Monroe, Wis., and has taken contracts amounting to $100,000 for waterworks plants at Sioux Rapids and Hawarden, Ia., and at Geneva Lake, Wis.

The Central Electric company, of Chicago, has had a private wire run into its office, connecting it with the Postal Telegraph system. This company seems to be constantly on the lookout for new methods of improving its facilities and giving its patrons the promptest possible attention.

The Eclipse Wind Engine works, of Beloit, Wis., is now prepared to execute orders for the complete equipment of power plants, including steam engines, sheaves, whole or split with friction clutches, for rope transmission, Eclipse friction pulleys, stands, shafting, etc., for electric light stations; everything, in fact, is furnished, except dynamos and conducting wires.

Noyes Bros. of 85 Fifth avenue, Chicago, have recently perfected their facilities for turning out a very high grade of brass work of all kinds. They make a specialty of electric brackets, electroliers, electric portable combination brackets, and small electric light fixtures of all kinds. They are preparing a new circular of their goods, which will be mailed to the trade in a few days

The Lunkenheimer Brass company of Cincinnati reports an unusually heavy business during the past three months. It is getting out a new sight feed lubricator, for which it is making great claims. It will probably be on the market in a few weeks. The business during the past year has increased to such an extent that it is now employing forty more men than a year ago.

At the Birmingham International exposition, a first prize medal was awarded for the Crocker-Wheeler motor. This apparatus is popular in England, and the Crocker-Wheeler company of New York have lately received orders for thirty-four complete motor and fan outfits. These small motors have decided advantages in efficiency, durability, simplicity and design, and it is claimed that they are the most successful small motor made.

Mr. Corey of the Electric Construction & Supply company, New York, is highly pleased with the success of the new arc lamp, which is now on exhibition at its store. The lamp presents a solid appearance and gives a steady and beautiful light on an Edison current of about 110 volts. This new lamp is the invention of Mr. Ward, the electrician of the company. The lamp is entirely new, and is the result of experience with the old Kinsman lamp.

The Union Iron works, of Erie, Pa., has been organized for the manufacture of steel boilers. The incorporators are: F. F. Cleveland and William Hardwick, of Cleveland & Hardwick; L. G. Skinner and Frank Connell, of the Skinner Engine company, and H. R. Barnhurst, of the Stearns Manufacturing company, all of Erie. A substantial brick building, 60x150 feet, is now in course of construction. It will be completed in a couple of weeks and the new company will be in possession and operating in about sixty days.

The Williams Engine company, whose works were recently completed at Beloit, Wis., is now at work on steam engines for the Detroit Electric Light and Power company, and for the Laclede Gas Light company, St. Louis. This company now has on its books unfilled orders amounting to more than $100,000. The success of the Williams triple expansion and compound condensing engines, which have now been in use two years, is so pronounced that the capacity of the works will soon be doubled by the addition of new buildings and the installation of additional machinery.

The Diamond Prospecting company, of Chicago, has recently brought out a type of drill which is designed to be operated by electricity. The machine is driven by a Thomson-Houston 3-horse power motor of special design. The drill is compact, is easily handled, and it will cut at any angle to a depth of 300 feet. In addition to the drill proper the motor operates a pump. Referring to the Diamond drill the *Engineering and Mining Journal* says: "The adoption of the Diamond drill to be operated by electricity cannot fail to widen largely the already rapidly growing field for these machines."

The Franklin Electric company of Chicago has been enlarging its quarters at 120 Randolph street. The demand for the new dry battery, which this company has recently developed and an increase of business in the experimental department, has necessitated the enlargement. E. E. Flora, president of the company, has recently patented the novel electric cigar lighter, which is being introduced by the Roper & Baxter Cigar company. A description of this specialty appeared last week in the WESTERN ELECTRICIAN. Mr. Flora reports that the efforts to introduce this lighter have been most successful, and that the manufacture of this one article alone would almost be a business in itself.

Force Bain of Chicago, in a letter addressed to the Central Electric company of Chicago, speaks of the excellent results attained in using okonite wire in mines. In one case he refers to an okonite cable used for conducting 60 amperes at 220 volts to a mining machine, situated 100 feet from the main conductors. "These wires," he says, "were laid along the ground in the mud, and were being daily trampled upon by mules and miners. It is useless to say that I have protested very strongly against such treatment, but they fail to construct their circuits differently as long as they continue so satisfactory in their present condition. This cable has been in daily use since about the first of last May."

Tatham & Brothers, 226-228 South Fifth street, Philadelphia, are now manufacturing a standard three-wire cable for the Edison company, Philadelphia. This is one of the largest cables ever turned out, and includes a main cable and feeders. The main cable is 2½ inches in diameter and the feeders are 2 inches. The cable is quite pliable and lead incased. The lead is protected with the P. & B. paint. The process of manufacture is quite original, and is claimed to turn out a superior cable. The lead is put on continuously and will not split, being forced around the core in such close contact that all moisture is excluded. Before the core is lead incased it is thoroughly dried out in an oven and then boiled in the Tatham electrical compound, which protects it from moisture and cold.

The Aluminum Battery Electric Light & Power company of New York recently gave a test exhibition of their primary cells. A large party of experts were present and a number of tests were made, which were highly satisfactory to the promoters of this new enterprise. The solution used in the battery is an "aluminum compound," and the elements are carbon and a compound of zinc, tin and aluminum. The electromotive force per cell is 2 volts, and the internal resistance less than .03 of an ohm. It is said that in the development of this battery some phenomena were observed that were never before met with, and the result was not only a highly efficient battery, but the opening up of new fields of investigation which may lead to important discoveries. The company reports a lively demand for their goods, and they now have over eighty orders to fill.

Westinghouse, Church, Kerr & Co. have opened an office at St. Louis. Five years ago this company began operations by opening offices in New York, handling almost exclusively the Westinghouse Standard engine. The company immediately gained public favor and success was soon assured. The development of the Westinghouse Junior and Compound engines has greatly increased their business, and from time to time other engineering specialties have been approved and purchased by them, forming a large item in their business. They confine themselves wholly to the generation and distribution of steam power, in which department their experience has perhaps been as extended as that of any other concern in the country. The continuous growth of their business has required the successive establishing of branch offices, first in Pittsburg and Philadelphia, and later in Boston and Chicago. The office at Chicago is conducted independently of the New York office, and has been equally successful. The Chicago and St. Louis offices are now controlling all the trade throughout the West and Southwest, to the Rocky Mountains.

The Northwestern Electrical Supply & Construction company of Seattle, Wash., has closed a contract with the Willamette Bridge Railway company of Portland, Ore., for a complete steam plant to consist of one 150 horse power Ball automatic cut-off engine, two 100 horse power boilers, with heater, etc. The Field Engineering company of New York city has placed an order with Chas. R. Vincent & Co., agents for the Ball Engine company, for two 150 horse power automatic cut-off high speed engines. These engines are to be used in an electric street railway at Winston, N. C., now being constructed. The Pennsylvania Normal school at Lock Haven, Pa., has placed an order with H. M. Sciple & Co., Third and Arch streets, Philadelphia, Pa., for a 50 horse power Ball automatic cut-off high speed engine. The Denver Electric Illuminating company of Denver, Colo., has recently purchased from the Ball Engine company one 125 horse power Ball engine making ten engines of this manufacture, aggregating 1,000 horse power sold them by the Ball company. The First Cincinnati Edison Electric Illuminating company of Cincinnati, has recently purchased a 150 horse power Ball automatic cut-off high speed engine. The Rittenhaus Manufacturing company of Passaic, N. J., has just bought a 25 horse power Ball automatic cut-off engine.

Electrical Patents.

Issued March 11, 1890.

422,910. System of Arc and Incandescent Electric Lighting. Harold P. Brown, Chicago, Ill. Filed Nov. 23, 1885.

The object of the invention is to provide a means of automatically shunting a greater or less portion of the current around the group of incandescent lamps, according to the number of lamps in use in the multiple arc group at any one time, so that whatever may be the number in use, each incandescent lamp will always receive its normal amount of current.

The second claim follows: "The combination, with a group of multiple working circuits and electrical devices included therein, of a resistance circuit around said group and an electro-magnet in a shunt or derived circuit to the group of working circuits, and arranged to vary or control the resistance circuits."

422,911. Electromotor. Henry R. Butterfield, Waterville, Me.

The invention relates more especially to that kind of electromotors, in which a vibrating pivoted armature is employed.

422,925. Zinc Electrode for Galvanic Batteries. Georges D'Infreville, New York, N. Y.

422,948. System for Stopping Machines. Washington H. Kilbourn, Olean, N. Y.

422,956. Electric Valve-Controller. Ernst R. Malmborg, St. Louis, Mo.

422,968. Electrically-Controlled Elevator. Walter J. Paine, Boston, Mass.

The invention may be applied to elevators or carriages. The movement of the vehicle may be automatically controlled from any one of the series of stations or stopping points, and also, if so desired, from the car itself.

422,975. Coupling Electric Motors. Edwin W. Rice, Jr., Lynn, Mass.

The first claim reads:

"In a system of power distribution, two or more compound wound electric motors simultaneously in use on the same work and each having its series field magnet coil connected with a point in the circuit to an armature of another, where the potential varies with changes in the counter electromotive force or resistance."

422,976. Reversing Trolley. Henry P. Roberts, Rochester, N. Y.

Claim 1 is as follows:

"In an electric railway, an overhead conductor supported at intervals by suitable means, one or more of the supporting points being at a different elevation from the other supporting points, in combination with a moving vehicle and a trolley-arm secured to the vehicle and carrying an under contact-trolley, said trolley-arm having the tendency to assume a position perpendicular to the line of movement to the vehicle."

422,981. Automatic Electrical Annunciator. Benjamin F. Shafer, New York, N. Y.

422,999. Field-Magnet for Dynamos. Elihu Thomson and Albert L. Rohrer, Lynn, Mass.

423,004. Overhead Electric System. William Vogler, Somerville, Mass.

The invention has for its object to suspend the trolley wire over the roadbed, so that the strain upon the same is diminished, and the said wire prevented from coming in contact with the ground in case it should become broken, whereby the danger which besets the present method of suspending the trolley-wire is obviated or reduced to a minimum.

423,005. Trolley-Wire Supporting Apparatus. William Vogler, Somerville, Mass.

423,014. Casing for Electric or Other Apparatus. Leander S. Woodbury, Calumet, Mich.

423,023. Underground Electric Conduit. Augustus Bruner, Indianapolis, Ind.

The claim reads:

"The process of constructing conduits which consists in placing a layer of concrete in a trench and setting one or more series of independent cores therein above each other, held in position at one end by a head-board, the other end of the cores being supported by the openings of the last section made, and filling in about the cores with a mass of homogeneous cement or similar material, allowing such mass to settle, and then withdrawing the cores."

423,026. Armature. Robert L. Cohen, Camden, N. J.

423,029. Regulation of Alternate Current Generators. Stanley C. C. Currie, Philadelphia, Pa.

423,091. Method of Preparing Active Material for Secondary Batteries. Charles Sorley, New York, N. Y.

423,101. Process of Electroplating Non-Metallic Articles. William H. Winslow, Chicago, Ill.

423,102. Thermal Cut-Out. James J. Wood, Brooklyn, N. Y.

423,134. Laying Electric Conductors. Thomas J. Cope, Philadelphia, Pa.

423,207. Portable Electric Lamp. Alexander H. Bauer, Chicago, Ill.

The object of the invention is to provide a portable electric lamp, which shall be particularly adapted for use in lighting the interior of passenger cars.

423,210. Electric Meter for Alternating Currents. Otto T. Blathy, Buda-Pesth, Austro-Hungary.

423,223. Electric-Heating Apparatus. Mark W. Dewey, Syracuse, N. Y.

The object of the invention is to provide a simple and efficient heater that will expose a large, radiating surface and occupy a very small space, so that it may be placed in waste room, as under the seats in cars and other vehicles.

423,229. Telegraphic Repeater. Sidney S. Emery, Newton Centre, Mass.

423,245. Electric Shaft-Controller. Anthony W. Hart, Boston, Mass.

423,286. Stationary Fire-Extinguishing Apparatus. William C. Smith, New Haven, Conn.

423,299. Ear-Phone for Telephones. Julius J. Wolf, Kansas City, Mo.

423,309. Holder for Commutator-Brushes. Jacob C. Chamberlain, New York, N. Y.

423,310. Connecting Device for Battery-Terminals. Rufus N. Chamberlain and Jacob C. Chamberlain, New York, N. Y.

423,324. Secondary Battery. William A. Johnson and James N. Smith, Toronto, Ontario, Canada.

423,335. Dry Galvanic Battery. Louis Moorthamers, Brussels, Belgium.

423,361. Coin-Operated Electric Apparatus. John S. Wallace, Belfast, Ireland.

423,385. Alarm for Gas-Pipes. Americus Miesse, Lima Ohio.

423,391. Trolley for Overhead Electric Railways. Frank B. Rae, Detroit, Mich.

Of the six claims, the fourth is given:

"In a contact-arm for electric railways, the combination, with the shaft and a disk-shaped socket-piece loosely mounted thereon, of springs mounted on the support and bearing laterally against the opposite sides of the disk."

423,400. Electric Motor Car. Detlef C. Voss, Medford, Mass.

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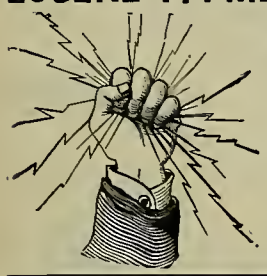

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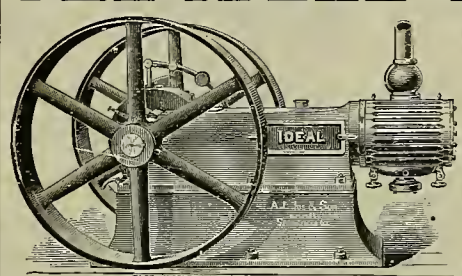

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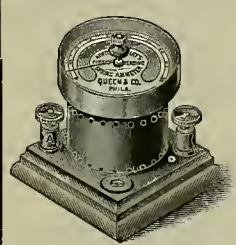

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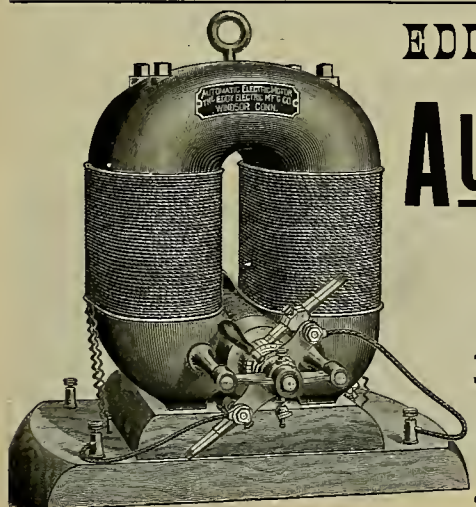

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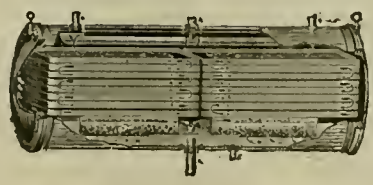

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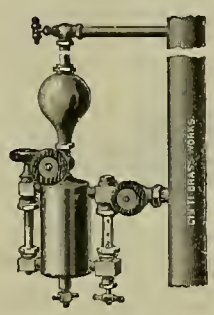

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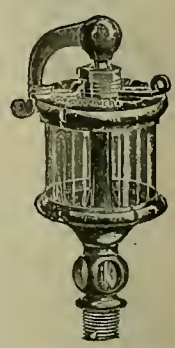

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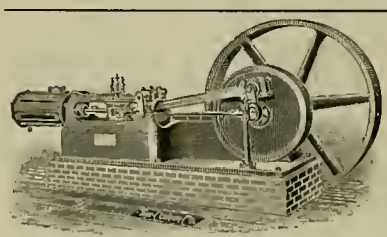

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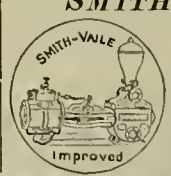

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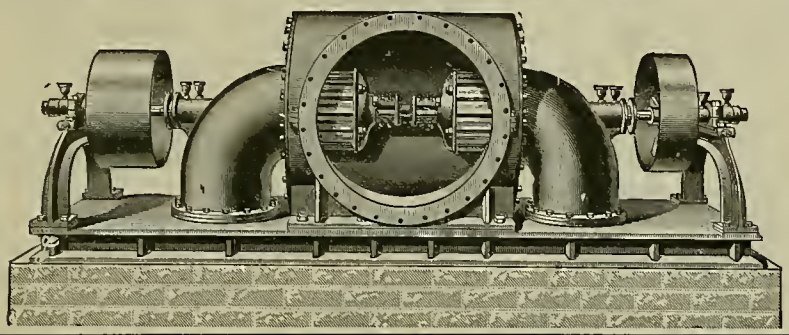

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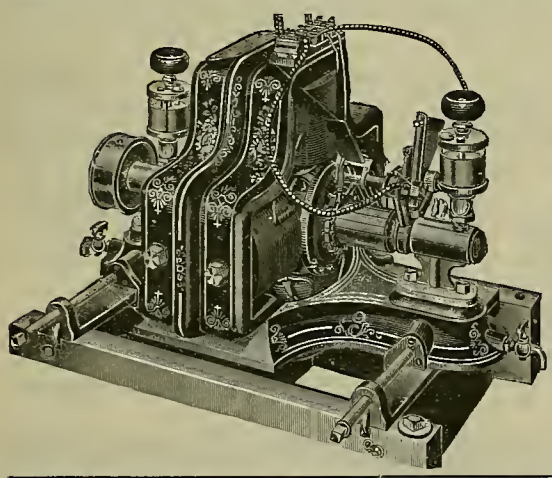

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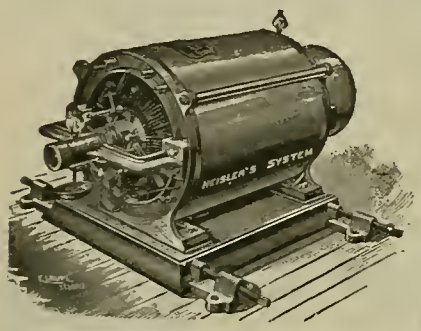

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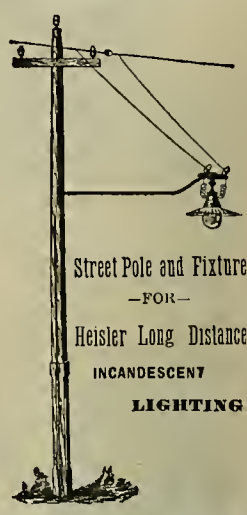

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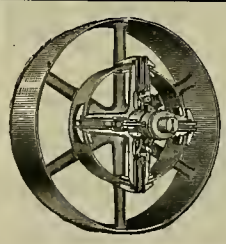

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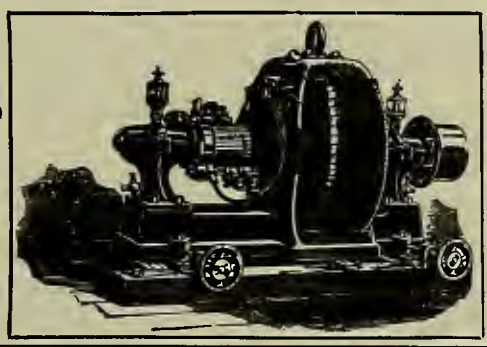

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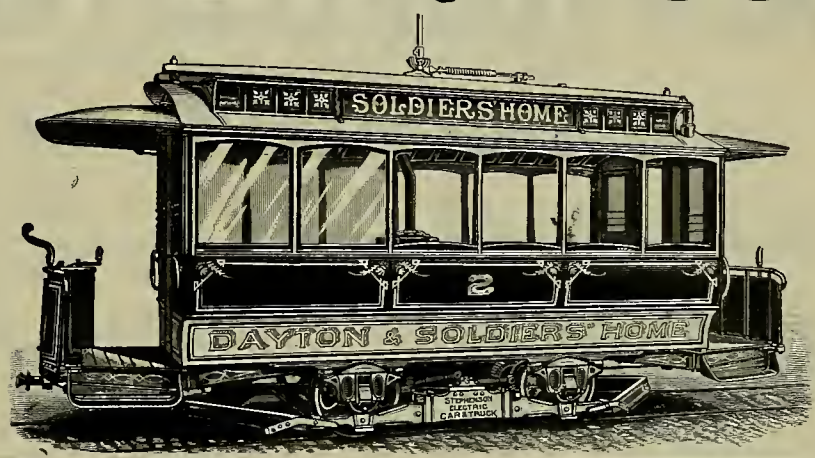

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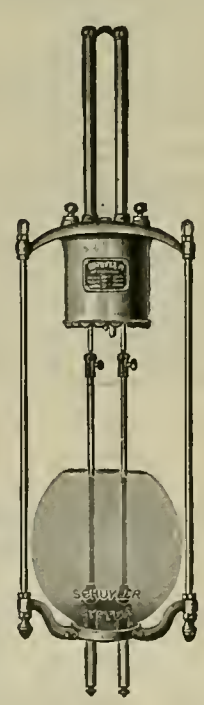

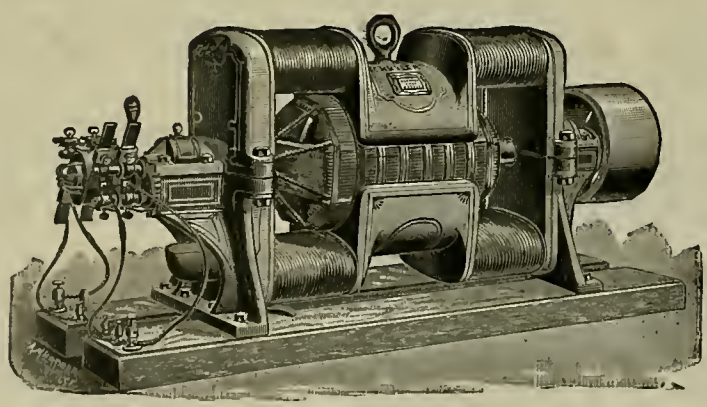

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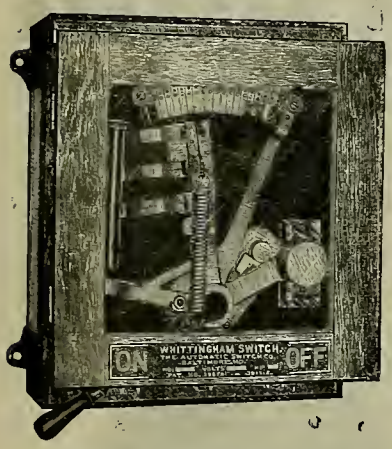

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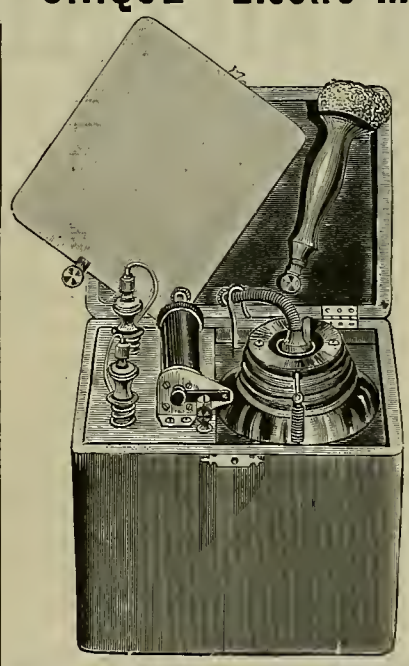

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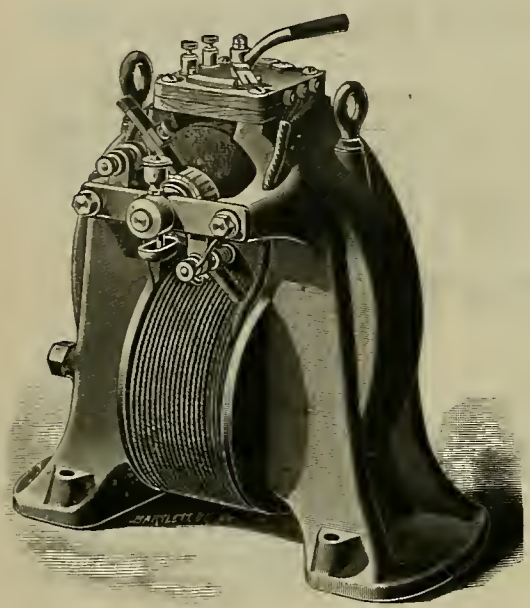

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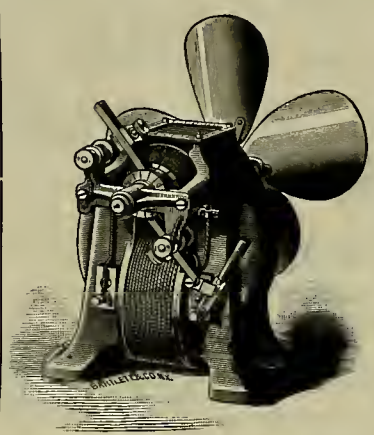

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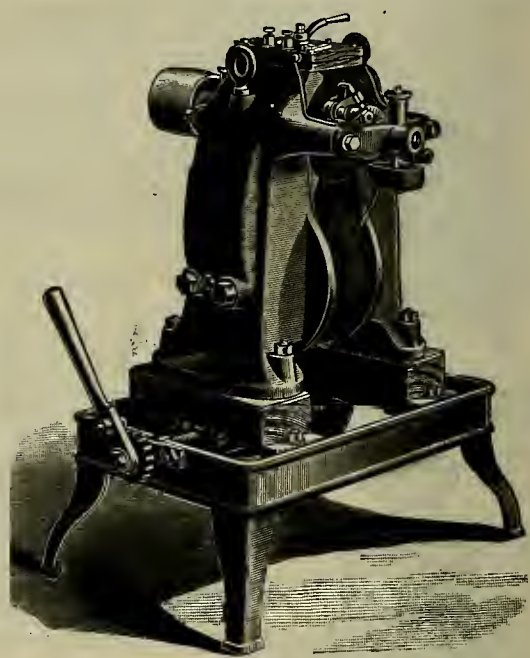

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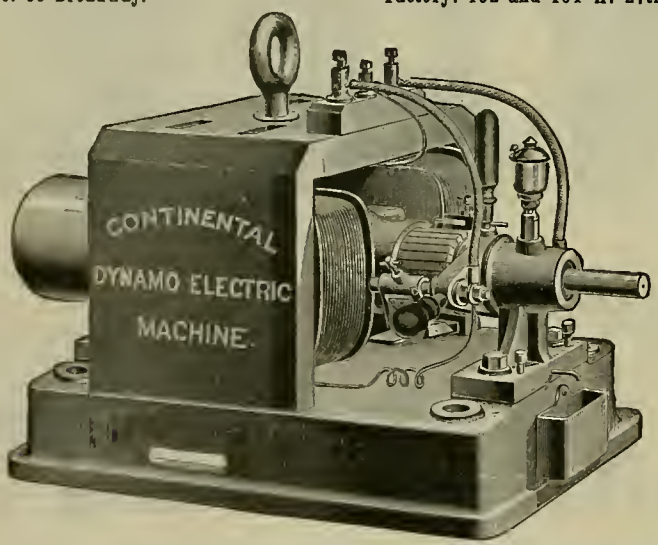

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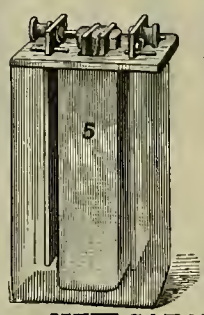

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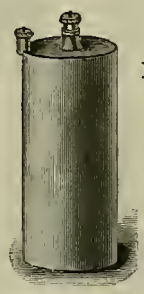

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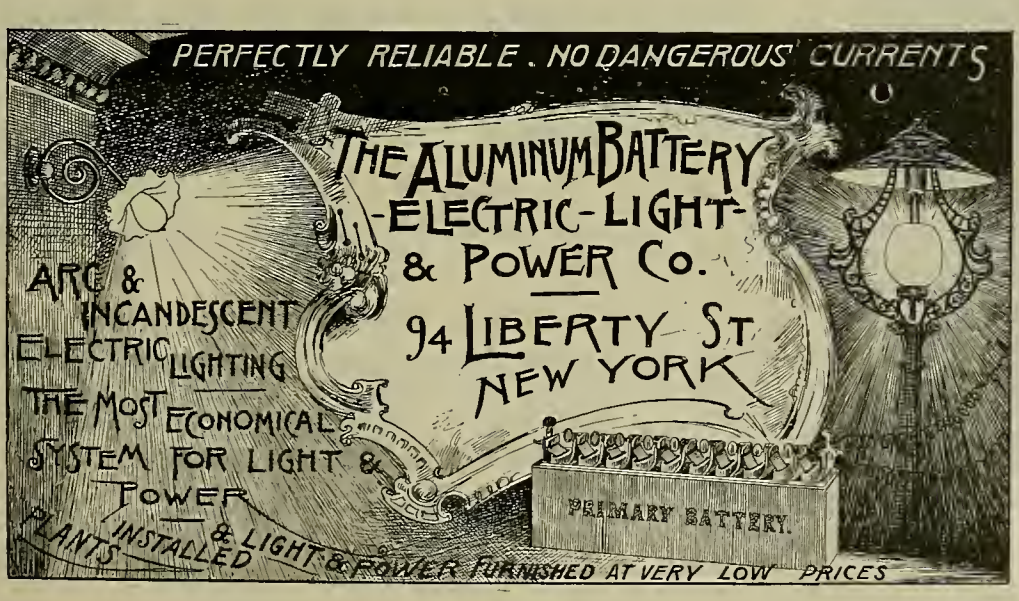

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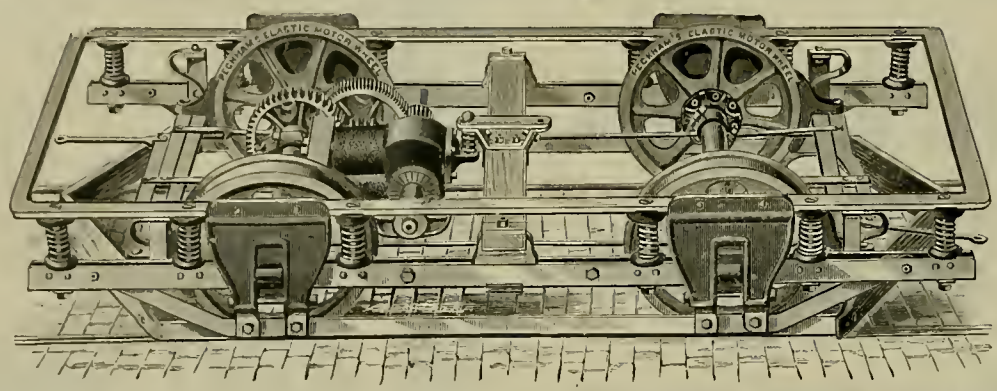

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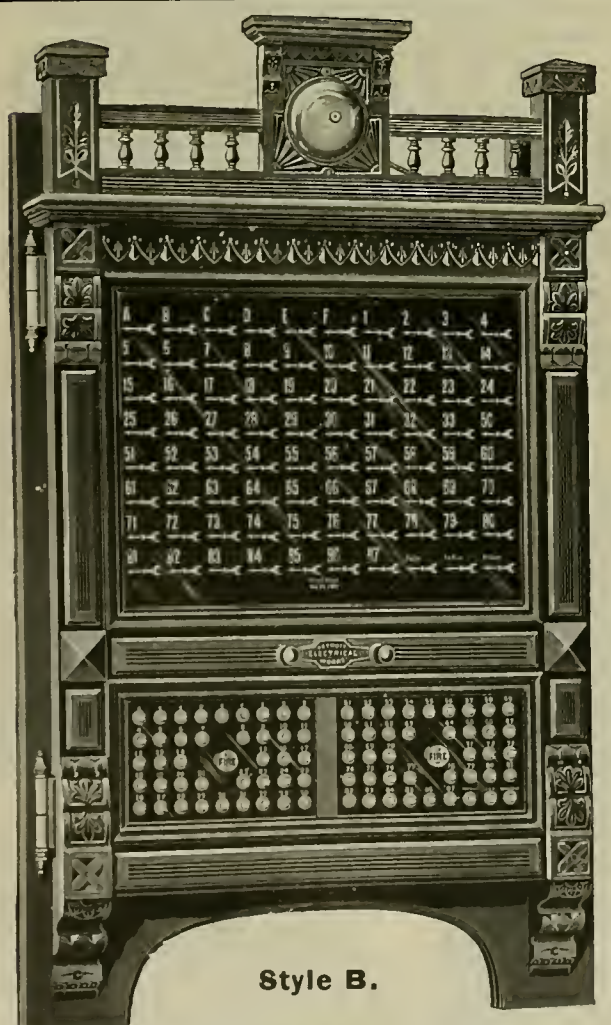

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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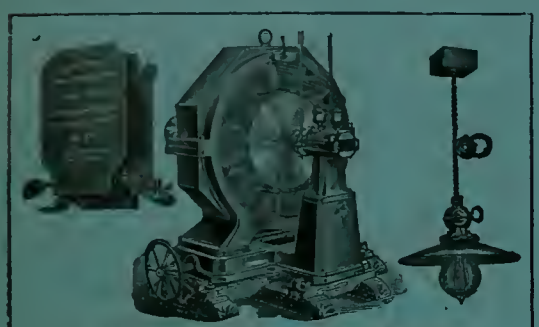

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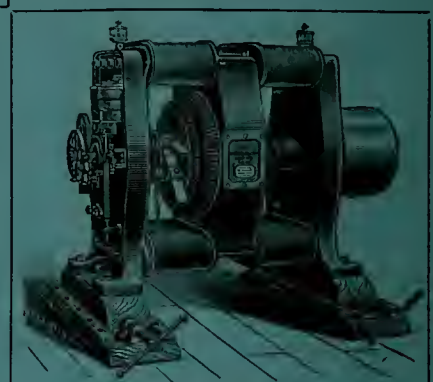

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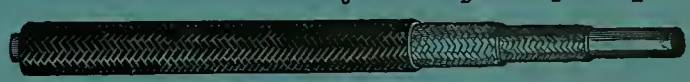

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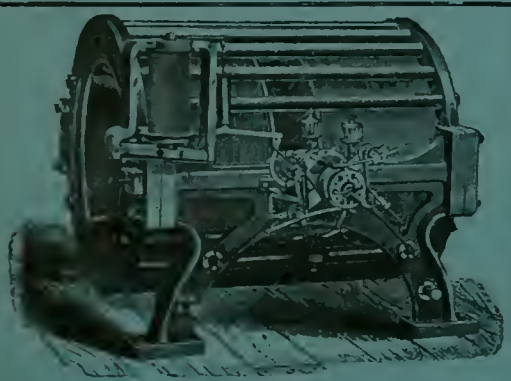

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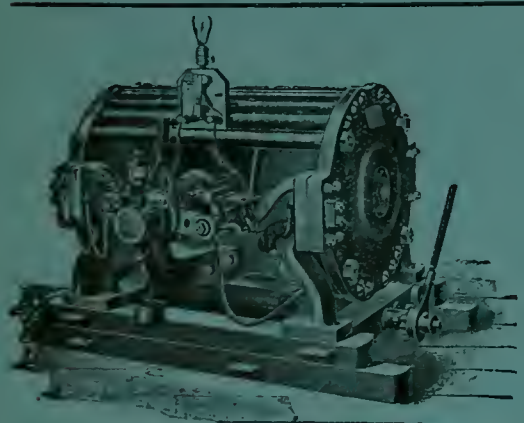

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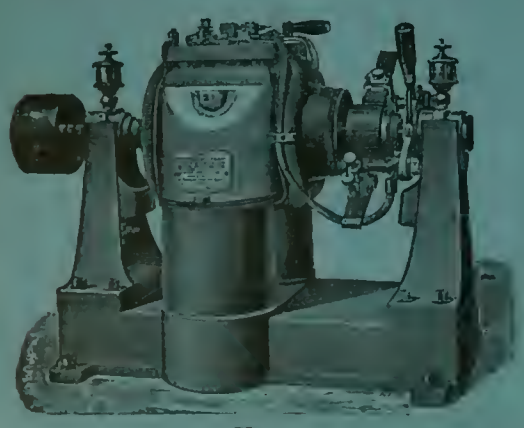

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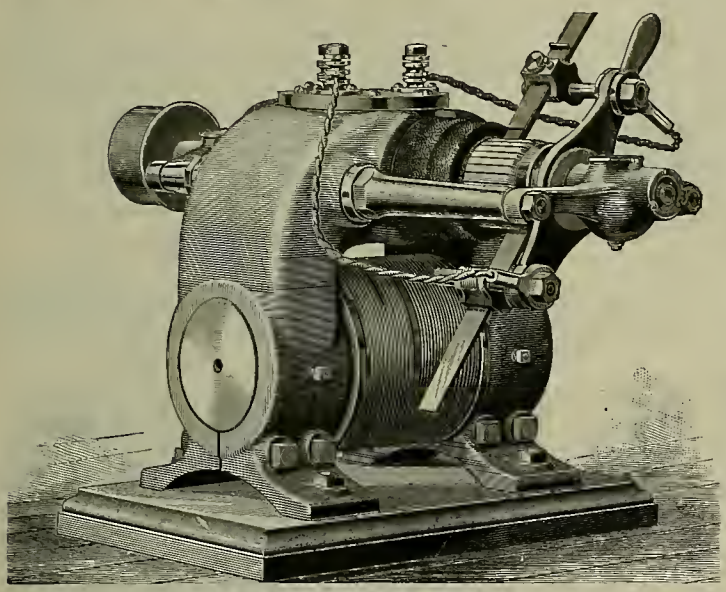

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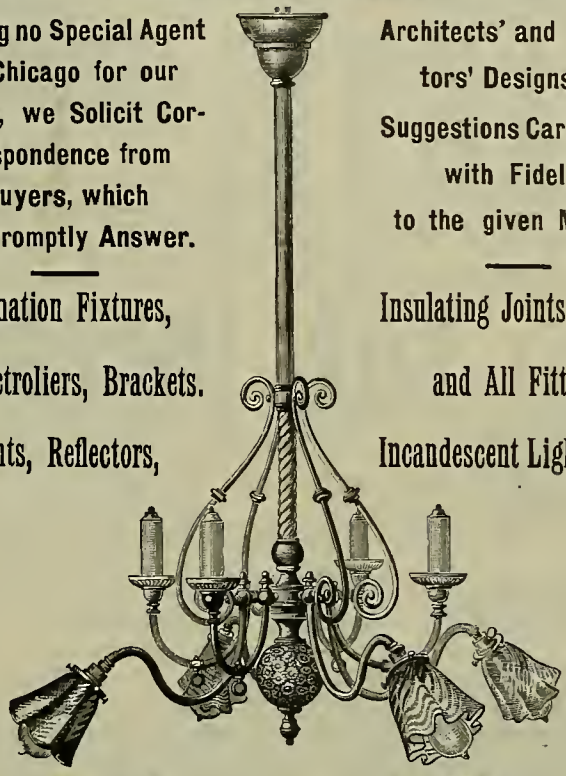

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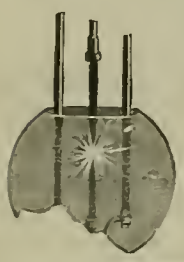

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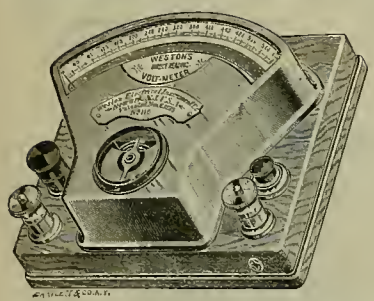

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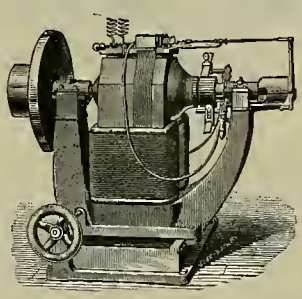

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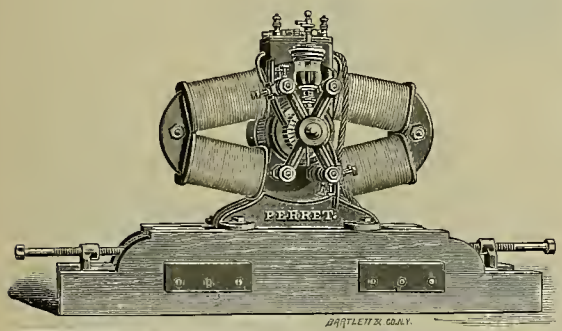

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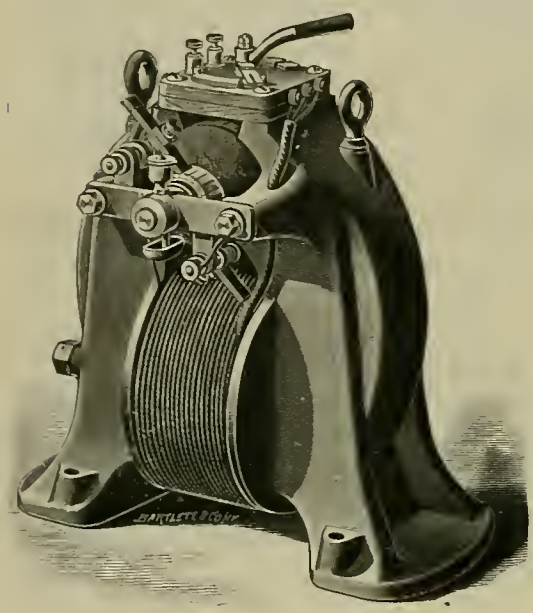
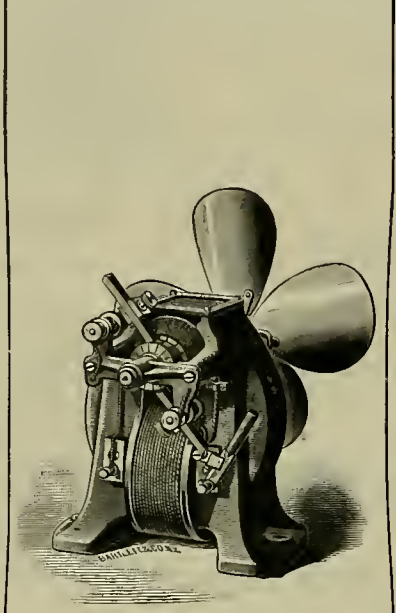
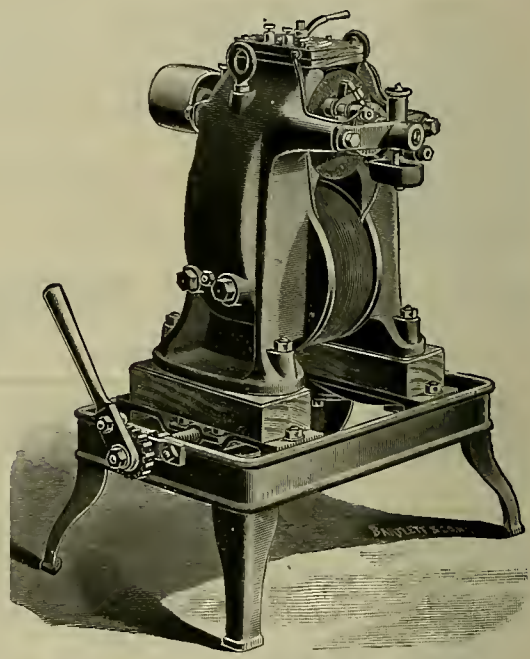


MOTOR WITHOUT BASE.



FAN MOTOR.



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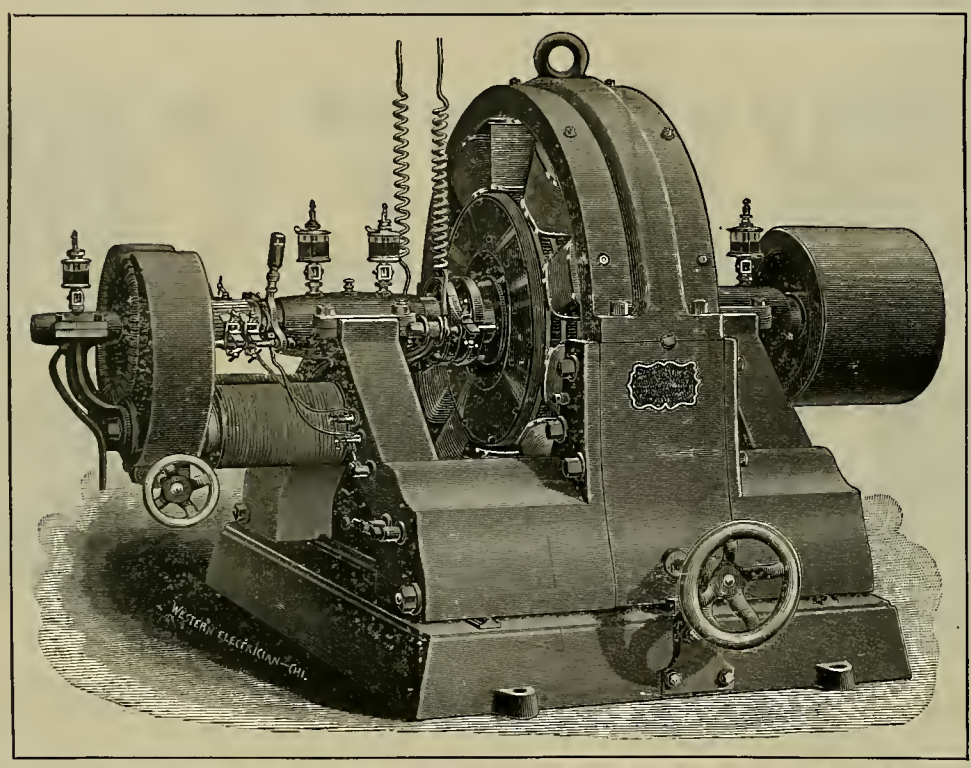

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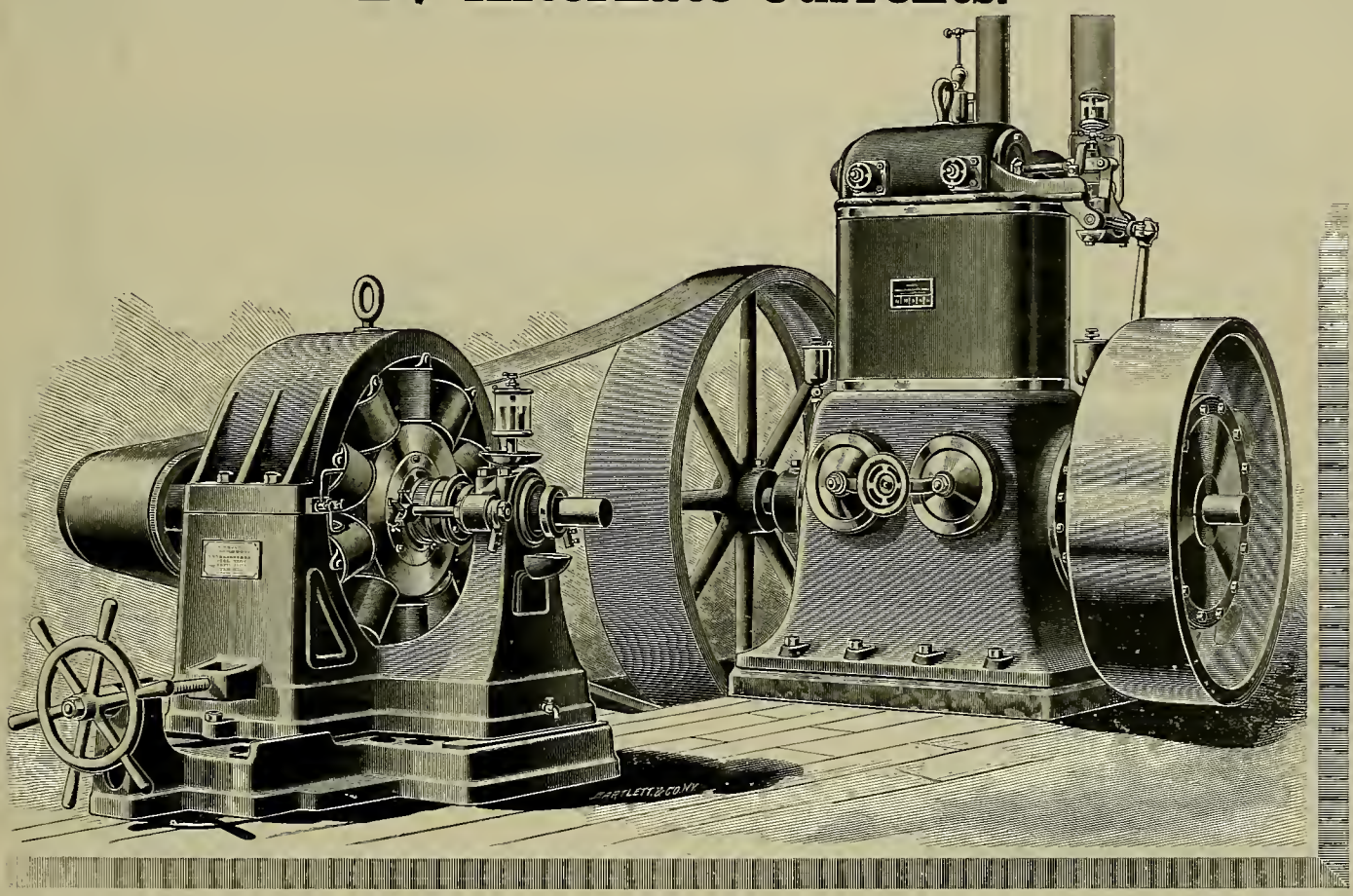

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All the lines in Minneapolis and St. Paul and between those two cities, comprising 200 miles of track, are to be equipped with the Sprague Electric System.

(Statement of Mr. Thos. Lowry, Prest. of the Minneapolis Street Rai'way.)

"NEW YORK, Feb. 19, 1890.—I have to-day closed contract with Sprague Electric Railway & Motor Co. for the Electrical Equipment of the Street Railways in Minneapolis and St. Paul, and between those two cities."

(Signed) *THOS. LOWRY, Prest.*

St. Louis follows with an order for sixty-eight car equipments for the Lindell St. Railwav in that city.

Total number of Street Railway Motors contracted for since January 1, 1890.----810.

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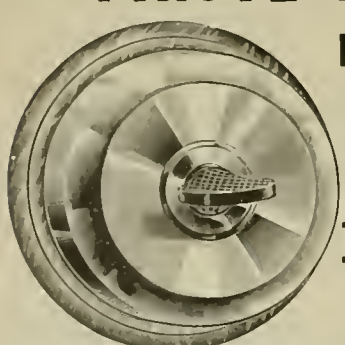

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The Standard Paint Co., 59 Maiden Lane, New York.

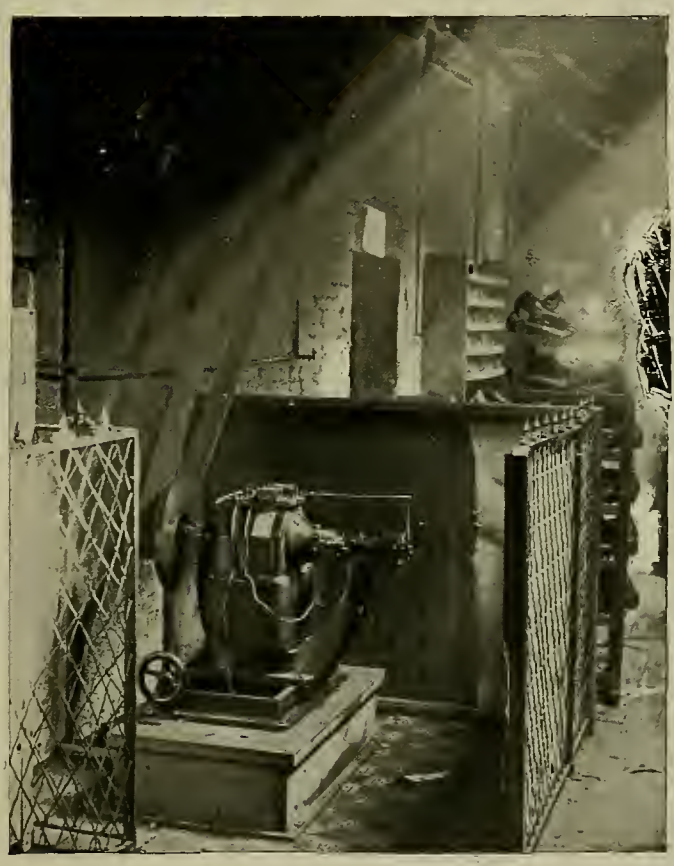
Western Electrician

EVERY SATURDAY.

Vol. VI. CHICAGO, MARCH 29, 1890. No. 13.

Excelsior Arc Motor in a Shoe Factory.

The fact that there are a number of Excelsior constant current motors running in Chicago on arc-light circuits is perhaps not generally known. About a year ago the western department of the Excelsior Electric company began an active canvass in Chicago for the purpose of introducing this type of machine. A number of motors were installed in the city on the circuits of the Chicago Arc Light & Power company. These lines, it may be stated, are all laid underground, and the motors operate with a 10-ampere current supplied from the new type of Excelsior constant current generator. A description of this last named machine was presented in the WESTERN ELECTRICIAN of March 15. A view of one or the most interesting installations made by this company in Chicago is presented in the accompanying illustration. The motor as represented, is in operation in the factory of the Waifs' Mission Training School, 42 State street. The capacity of the motor is 10-horse power at a speed of 1,600 revolutions. In addition to a main shaft 80 feet in length this machine drives one countershaft 40 feet long and three other lines of shafting, each 30 feet in length. The machinery in the factory, all of which is supplied with power by the motor, consists of 18 heavy shoe machines of various types, and 39 sewing machines. The factory furnishes employment to 50 boys; half this number working in the forenoon and the remainder coming on in the afternoon. As the motor is now running it is not worked up to its full capacity, and it is intended to add more machinery to the plant.



EXCELSIOR ARC MOTOR IN A SHOE FACTORY.

Electrical Execution Constitutional.

The Court of Appeals at Albany, March 21, declared the electrical execution act constitutional and affirmed the judgment against William Kemmler, the Buffalo murderer. Judge O'Brien who wrote the decision, says: "The only question involved in the appeal is whether the statute relating to electrical executions is in conflict with the provision of the state constitution, which forbids the infliction of cruel and unusual punishment. The statute describes no new punishment for this offence. The punishment is death, as heretofore, the only change being in the mode of carrying it out. The relator attempts to show that the new mode is torturous. This argument would apply with equal force to any untried method and if carried out would prohibit the death penalty. Every act of the legislature must be presumed to be in harmony with the fundamental law until proved contrary. The decision of the legislature is conclusive upon the court."

The court finds that the mode proposed is not cruel within the meaning of the constitution, though unusual. On the contrary, all agree with the court below that it removes every reasonable doubt that the application of electricity to the vital parts of the human body under such conditions and in the manner contemplated by the statute must result in instantaneous and consequently painless death. The decision refers to the appointment by the legislature of the commission to investigate humane methods of death punishment and the enactment of the statute under consideration, and adds:

"The legislature proceeded with care and caution, and with unusual deliberation. It would be a strange result if it could be now charged and held that they had obtained a more cruel method. Whether or not electricity is more humane was a question for the legislature alone to determine."

There are now five convicts awaiting execution under the new law in New York state, and in the tombs alone there are nineteen untried prisoners charged with murder. Kemmler's was the first conviction under the new law and his will, in all probability, be the first execution. Slocum, the last convict condemned, was sentenced by Judge Martine on the day the law was declared constitutional. The prisoners are all from the lowest walks in life, and the murders of which they were convicted were of such a revolting character that not the least sympathy was exhibited toward the prisoners personally. The whole effort to have the law set aside was on account of the manner in which the executions were to be conducted, and the evident intention of turning the law to account in commercial transactions.

Canadian Patent Bill.

An important bill is pending in the Canadian parliament, amending the patent act, the terms of which provide that when the validity of a patent is questioned under the provisions of Section 37, such dispute shall be decided by the Exchequer or other competent courts of Canada, instead of by the minister of agriculture, or his deputy, as provided by the existing statute.

Section 37, referred to, provides that disputes must come before the minister of agriculture or his deputy, and that their decisions are final. They have not the right to swear witnesses. According to the new bill, there will be the usual rights of appeal to higher courts.

Minneapolis and St. Paul Electric Railways.

It is now stated that the Minneapolis & St. Paul electric railway systems will be equipped with both the Sprague and Thomson-Houston motors. Mr. Lowry, in a recent interview, said: "We have made a contract with the Sprague people for a large number of motors. We can also contract with the Thomson-Houston company for motors. We will probably require at least 200 motors for the two cities. We are looking for the very best, and the best will be had. We will not discriminate in favor of any special company. The two companies named are at the present time full of orders. If it were only a matter of letting the whole contract and allowing the company to take its time about getting them out, it would be different. But we want the motors ready as soon as the tracks are down, and the work of laying the tracks will, as I have said before, be pushed forward with the utmost rapidity. I can see nothing in the situation which would make me think there was any possibility of not having the new lines in operation by July 1. We are going to put in our own shop and do our own work. We will supply the needs of each company. We are going to put up our own wires, lay our own tracks, and have our own electricians. While the Thomson-Houston company has not yet got an order from our company, the chances are that the work will be pretty well divided between that company and the Sprague. There is no special difference between the systems so far as I can see. Both are first-class. However, each combines features which, if combined in each other, would make a motor which would be perfectly faultless."

Foree Bain of Chicago, has been selected as consulting electrician of the Minneapolis & St. Paul roads.

Kansas State Electric Light Association.

Representatives of the electric light companies doing business in Kansas met at Topeka March 19th, and organized a state association of central station companies under the name of the Kansas State Electric association, to promote the legitimate growth of the business; the securing of uniformity in regulations for inspection of construction and inside wiring; also underwriters' rules for insurance, and to give such assistance and advice to the companies in its membership as may be consistent with the general interests of the industry and the benefit of consumers. Officers were elected as follows: L. A. Beebe, Hutchinson, president; G. F. Parmelee, Topeka, vice-president; J. C. Fuller, Winfield, second vice-president; R. C. Johnston, Lawrence, secretary and treasurer.

Michales Electric Mining Machine.

The use of electricity in mining seems to give promise of the solution of many perplexing problems in transmitting power. The arguments in favor of its use in mines are many, and its introduction for many kinds of underground work is destined to form a most important branch

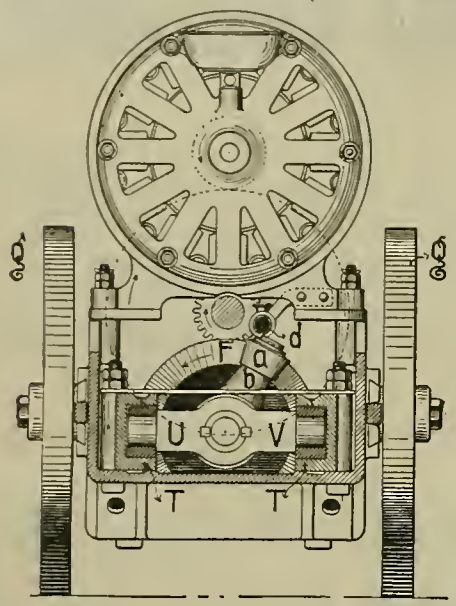


FIG. 3. MICHALES MINING MACHINE.

of electrical engineering. The accompanying cuts illustrate a simple machine, designed for coal cutting. The inventor is Capt. M. A. Michales of Pittsburg, Pa., who was assisted in perfecting his invention by Dr. O. S. Weddell of McKeesport. Fig. 1 is a side view with one-half of the machine proper removed. Fig. 2 is a top plan view with motor removed. Fig. 3 is a detailed view showing revolving cam *F*, thumb *b*, and cross-head *U V* of the drill bar. Fig. 4 is a rear and elevation. As will be noticed from the engravings, the machine is mounted on a two-wheeled truck. It is nine feet in length, one and one-half feet in width, two feet eight inches in height, and weighs about 850 pounds. It is supported with sliding axles *X X* for the purpose of balancing when a shorter or longer pick *R* is used. It is mounted with a 2 horse power Tesla motor *A* from which the power is transmitted through a combination of gear wheels, *B C E* and shafting *D* to a cam *F*, surrounding the drill bar *I*. Within this cam *F*, on the drill bar *I*, is placed a thumb *b*, on the end of which is a small trolley wheel *a*, to prevent friction as the cam *F* passes in front of it. By the rotation of this cam *F*, its inclined surface *F'*, Fig. 3, passes in front of this trolley wheel *a*, Fig. 3, forcing it back and up the incline *F'*, Fig. 3, drawing with it the drill bar *I*, against the tension of a powerful spring *K*, which encircles it, until the vertical wall of the cam *F* passes beyond the trolley wheel *a*, Fig. 3, when it is automatically released and forced violently forward by the action of the spring *K*, the trolley wheel *a*, Fig. 3, returning to the bottom of the incline *F'*. In order to lessen the effect of a shock, to which the machine would be subjected, in case the pick *R* should not strike against the coal, a powerful spring *N* is interposed between the shoulder *M* on the drill bar *I*, and the front end of the tube *L*, which surrounds it. The springs *K* and *N* can be changed in a moment, as the character of the work requires. The machine strikes 120 blows per minute, with a force of 9,000 pounds to the blow.

To convey the current from the dynamo at the entrance of the mine to the motor on the machine, well insulated wires are strung along the side of the entries near the roof, being fastened to the props or plugs placed in the coal for this purpose. Switches are placed opposite the entrance to each room in order to facilitate the changing of the machine from room to room. Wires are coupled to the main circuit in the entry to convey the current to the machine.

The Tesla alternating current motor, manufactured by the Westinghouse Electric company, has been adopted for operating the machine. The most unique and especially valuable feature claimed for this motor is that the current in the armature is an induced current. The ends of the armature wires are soldered together, and there is no electrical connection between them and the outside circuits. No brushes are required. The absence of commutator and brushes allows the armature, which is the only moving part of the motor to be completely inclosed and protected from mechanical injury. No regulator of any kind is used, and the only piece of apparatus in connection with the motor is a simple switch.

Lights can be taken off the circuit at any point desired. When a room or mine is finished the wires can be taken down quickly, and removed to another room.

One unique feature of t' is machine consists in the fact that at whatever point in the stroke the pick is arrested, it is instantly returned ready

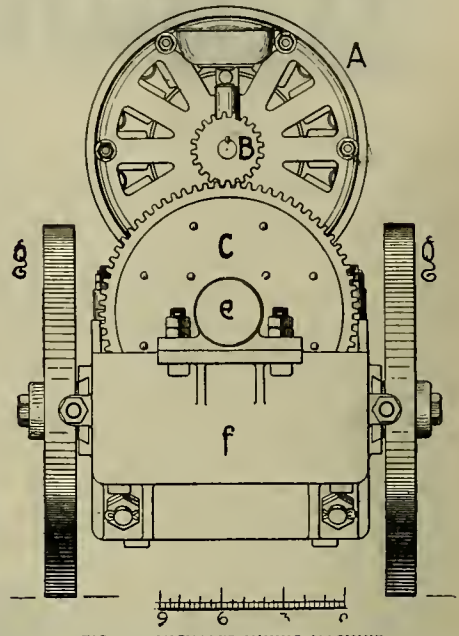


FIG. 4. MICHALES MINING MACHINE.

for the next blow; and when the blow is delivered, even though it be arrested in its course, instead of the machine pushing itself away from the coal, it rather inclines to it, owing to the momentum of the drill bar. It will not interfere with the working of the machine where it is necessary to place it close to the face of the coal.

The machine is light, and it is claimed easy to handle; being composed principally of steel, it is strong and durable. The method of operating the machine is as follows: The machine having been placed in front of the coal, the operator takes his seat behind it and locates each blow as would the hand miner where it will be most effective, cutting from four to six feet deep. This cut is made on a level with the floor, being of a V shape, eight inches in front and tapering back to two inches in the rear, making an average cut of five inches. When the under cut is made, the operator in like manner can shear the end.

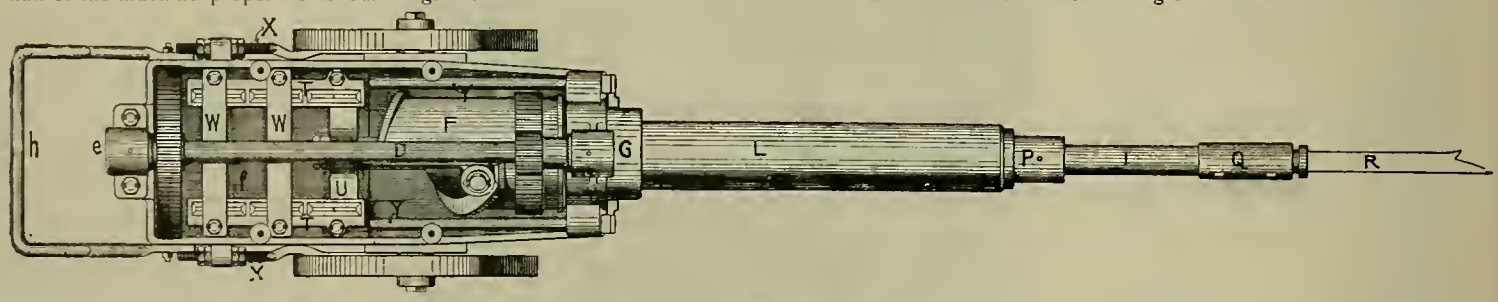


FIG. 2. MICHALES MINING MACHINE.

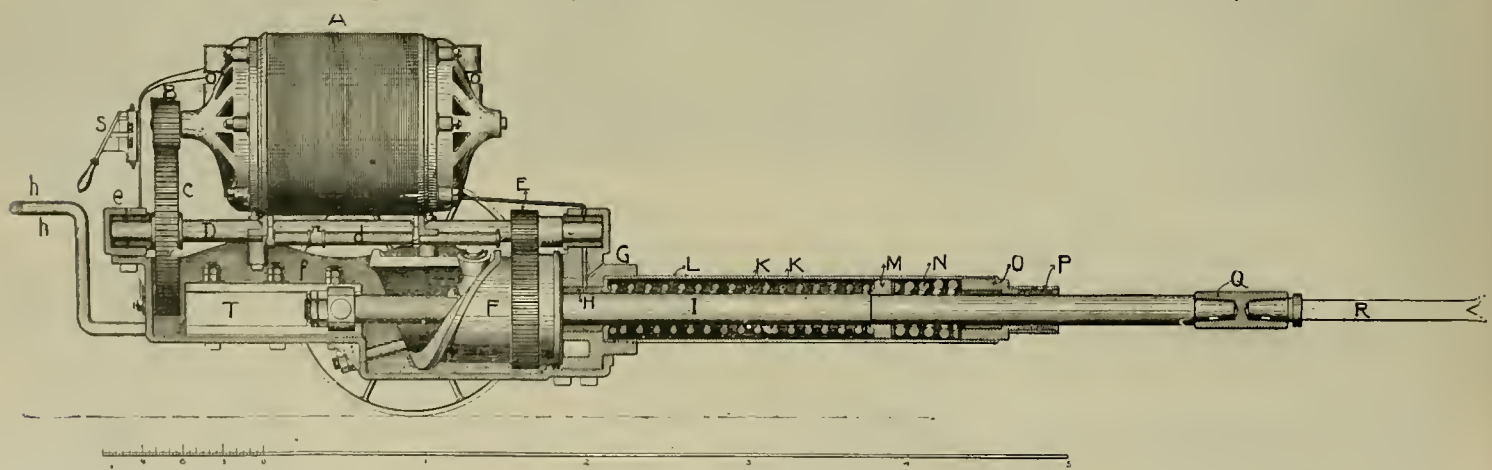


FIG. 1. MICHALES MINING MACHINE.

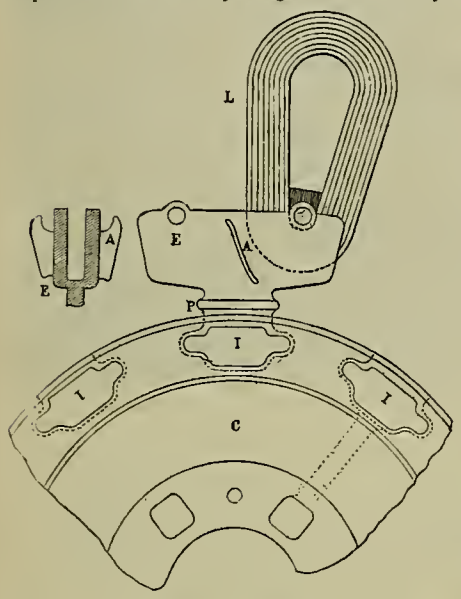
The motor has been operated with a pressure of 250 to 300 volts. It can easily be constructed for use with either a higher or lower pressure, according to the requirements in special cases. The extreme simplicity of the electrical part of this mining machine made it possible to put it into the hands of miners who have had no previous experience with electrical machinery.

One great advantage of this V-shaped cut is that, when the coal falls it will roll over and out of its original position, where it can be very advantageously loaded. It requires one man and helper to operate the machine.

The machine has been thoroughly tested in the hardest coal in Western Pennsylvania and the results have been of a most gratifying nature. The machine is introduced by the Michales Mining Machine company, Pittsburg, Pa.

Ferranti Armature.

The method of constructing the armature of the Ferranti dynamo is represented in the accompanying cut. The armature is composed of a series of flat coils, which are made of copper ribbon. Each layer of the copper is insulated by means of paper. The coils are shown at *L* in the cut. They are attached in pairs on a bronze strap *E*, and are insulated by means of the porcelain support, *P*, and sealed in *C* by sulphur run into the openings *I*. The body of



FERRANTI ARMATURE.

the armature, *C*, is attached directly to the shaft of the machine. Ventilation is effected by the wings *A*, which are on the bronze casting. The ends of the armature coils are connected to two rings at the end of the shaft by two thickly-insulated conductors. Special forms of collecting rings conduct the current to the outside circuit. The collecting rings are inclosed in a glass case, so that danger of an accidental contact is averted. The cut is reproduced from *Electricite*.

Seeing by Electricity.

In the course of an article on seeing by electricity, the London *Electrician* says: At present the main difficulty lies not so much in the design of transmitting or receiving organs as in the necessary complexity of an apparatus which shall enable innumerable points in the transmitting and receiving retinas to be actuated simultaneously in perfect independence, but also in perfect correspondence. If it were not desired to obtain actual views - if, in fact, simultaneity of action were not insisted on—then one line wire, successively connected to the separate corresponding points of the picture at the transmitting and receiving ends by some appropriate synchronizing mechanism, might be made to do duty for a large number of cells, instead of employing a separate line for each. But this is not seeing by electricity; it is merely reproducing a pattern or print automatically, point by point, by electricity. And, indeed, this was done nigh ten years ago by Shelford Bidwell when he devised his telephotographic apparatus. Since that time the subject of electric transmission of pictures has not advanced a single step. We do not, of course, forget that it is now proven that light is itself an electric phenomenon—that waves of light are, in fact, electric waves—and that all seeing is really seeing by electricity. But, since it is a fundamental point in the modern science of electricity that all conductors so-called are necessarily opaque to electric radiation, the recognition that light waves are electric waves adds nothing to the possibility of seeing through an electric wire.

Now, consider what sort of an electric mechanism could possibly act as a far-seeing eye, in the same sense as a telephone acts as a far-hearing ear. The transmitting part must resemble the retina of the eye in being differentiated into a vast group of minute independent structures, sensitive electrically to light. Theoretically these could be constructed out of selenium cells, selenium being, as every electrician knows, sensitive to light. Imagine, then, a set of selenium cells, a million in number, arranged like the squares of a chess board, or like the cells of a honeycomb, side by side if each is only of the size of one square millimeter this electric retina will occupy a square meter of space; in front of this, a combination of lenses to form an image, which combination could not well have a less focal length than one and a half meters. 'Tis a gigantic electric eye. But the transmitter is only half the apparatus. At the other end must be a receiving apparatus to reproduce the image.

The Sperry Constant Current Motor.

The accompanying cuts illustrate a new type of constant current motor, which has recently been invented by Elmer A. Sperry of Chicago.

In this new machine the inventor employs a stationary armature and a revolving field magnet in combination with a peculiar form of centrifugal governor. In Fig. 1 is shown the general construction of the motor. Fig. 2 is a sectional view of the annular stationary armature, inclosing the core of the revolving field. The core is represented in this cut without wire. The coils of the armature are connected to the segments of an annular commutator *C*, as represented in Fig. 1. Bearing upon the face of this commutator are the contact-brushes *E* and *E*. These brushes are carried by a yoke, whose position relative to the revolving field, is controlled by a centrifugal device, similar to that represented in Fig. 3. The manner in which this device connects with the brush-yoke is shown at *L* in Fig. 1. Current is supplied to the revolving field magnet by means of brushes in contact with the rings *N*. The electrical connections in the motor will be understood by reference to Fig. 1. The operation of the machine is as follows: It will be readily seen that any movement of the weighted arms, *B B* of the centrifugal device, or governor more properly speaking, due to a change of speed, will swing the brush-yoke. The circulation of current in this armature is the same as that in any ordinary Gramme armature, consequently the polarity of the ring is dependent upon the position of the brushes *E E*. The well-known repellant and attractive force is therefore exerted in a maximum degree, and tends to rotate the field-magnet in one direction or the other, dependent upon the respective polarities when there are intense poles at *M*, *M'*, *F* and *F'* in Fig. 2. Changes in the speed of the field-magnet, however, through the agency of the centrifugal governor, Fig. 3, as before stated, affect the position of the brush-yoke relative to the field-magnet, consequently any slight change of speed due to variation in the load on the motor is met by a corresponding change in "pull." A practically constant speed is the result. In addition to the method of regulation just described, Mr. Sperry employs other means of varying the intensity of the rotative action between the armature and field-magnet. For instance, this intensity may be varied by cutting out by means of the centrifugal device all or portions of the field-magnet coils from circuit.

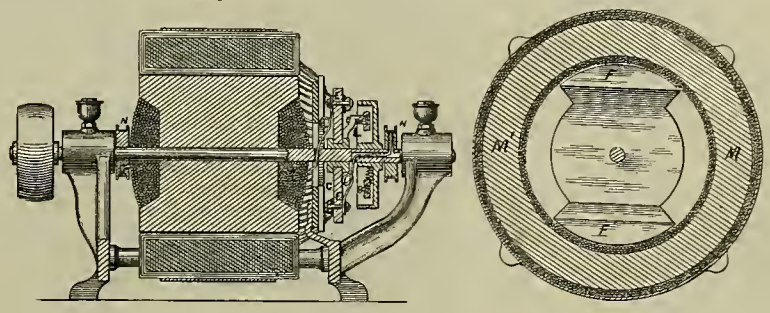
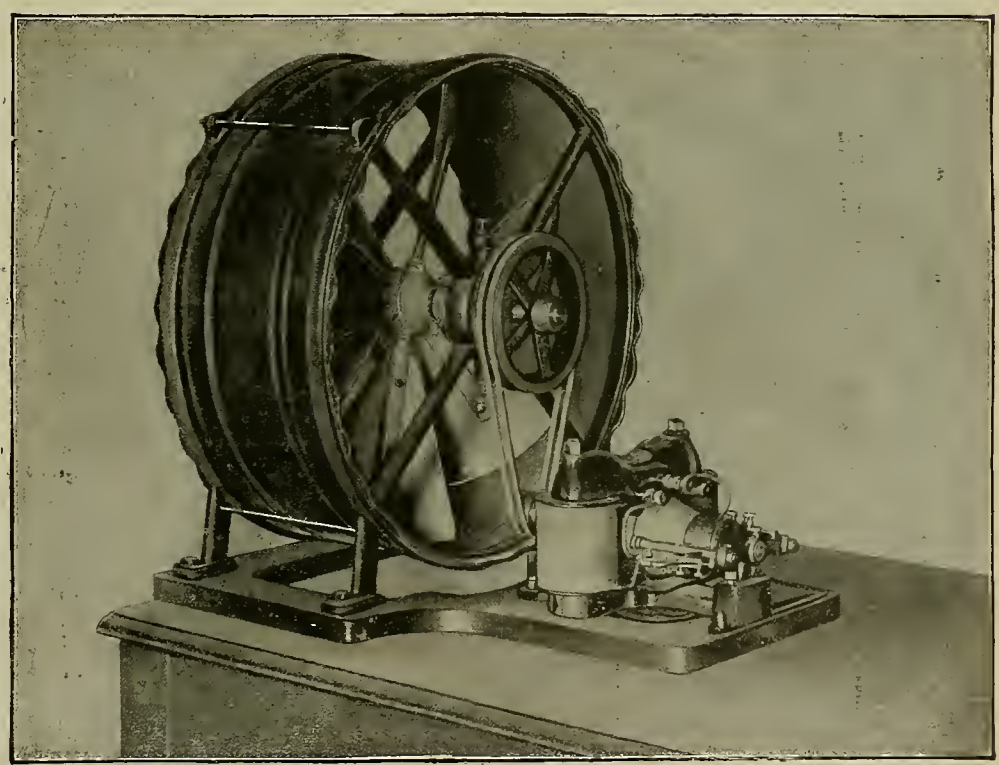


FIG. 1. FIG. 2. FIG. 3.

SPERRY CONSTANT CURRENT MOTOR.

Combination Stationary Motor and Fan.

A new combination of electric motor and fan which has recently been brought out by the Sprague Electric Railway & Motor company, is shown in the accompanying cut. As shown in the view, the motor and fan are both on the same stand, the motor being belted directly to the fan.



COMBINATION STATIONARY MOTOR AND FAN.

The motor, on account of its winding, can be put in operation by the simple movement of a switch, and stopped as easily; there is no necessity of using a rheostat in connection with the motor.

The Northern Trust company of Chicago, has advanced $500,000 to the Milwaukee Electric Railway company, Hinsey's lines, to complete, improve and extend the equipment of its system.

Constant Potential with Over-Compounded Dynamos.

By Alex. Dow.

The ideal constant potential distribution is that which maintains at the terminals of the lamp, motor, transformer or other translating device, the same potential difference under all working conditions. This ideal is attained to-day in many installations within 1 per cent. The usual specification now requires that the manufacturers guarantee against a greater variation than 1 per cent. from the standard, thus allowing a range from permissible minimum to permissible maximum potential of 2 per cent. of the total.

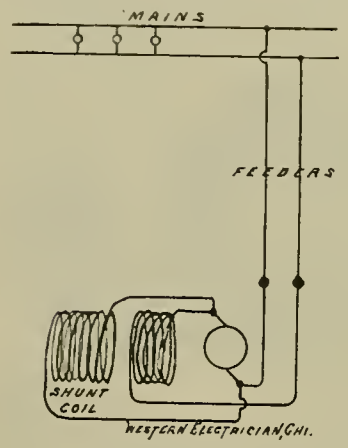


FIG. 1. CONSTANT POTENTIAL WITH OVER-COMPOUNDED DYNAMOS.

Given a generator that will maintain constant potential at its terminals, the loss of potential due to the resistance of the conductors between the generator and translating device is the only factor to be taken into account. In practice this loss of potential—call it "transmission loss"—is a variable, the current changing with the work done in the system. Varying the conductor resistance to maintain equal transmission loss is not readily practicable, nor is it economical. Varying the potential difference at the generator is the usual method. As the potential difference must increase in accordance with the increased current output, a method of increase controlled by the current will be automatic. The generator being a dynamo, with its field not saturated, what method is more appropriate than a supplementary series winding of proper proportions? And the "over-compounded" dynamo is evolved, which is the dynamo *par excellence* of to-day.

The calculation of the value of the supplementary winding has been discussed lately in the Western Electrician. It has been shown that there is a disturbing factor in the calculation—namely, the variation of the value of the original "constant potential" winding by the increased e. m. f. due to the supplementary winding. To illustrate: A dynamo is originally wound to maintain 110 volts at its terminals. It is then over-compounded so as to give 110 to 115 volts in proportion to current output. But the value of the original winding, presumably a shunt coil, is enhanced by its receiving a terminal pressure greater than designed; and the supplementary or series winding cannot be calculated without allowing for the increased effect of the shunt.

There are two methods of connecting the compound fields, familiarly called "short shunt," Fig. 1, in which the shunt coil parallels the armature only, and the "long shunt," Fig. 2, in which the shunt coil is connected to the terminals, and parallels the armature and series coil. I desire to point out another method of connection which eliminates the disturbing factor, illustrated in the preceding paragraph. The shunt winding may be connected "on the system," Fig. 3, that is, on the mains, or lamp leads, or trolley wire and ground, which are to be kept at a constant potential difference. This method obviously will give the shunt winding a constant instead of a varying value, and the series winding can be calculated of full magnetic value to compensate for the transmission loss—a very simple matter.

As to the practicability of this plan, it may be said that there are few constant potential plants in which the distributing mains do not return to the power station. Even where the mains need not for commercial reasons be led back, they are so returned as "pressure wires," or to light the station. No additional outside construction, therefore, is necessary. The shunt is simply disconnected from the dynamo or feeder bars, and connected to the mains.

This method of connection can often be applied with advantage to dynamos which have been already fitted with a series coil, and the value of the latter adjusted to a standard. Such dynamos are usually over-compounded 5, 10 or 15 per cent. These are convenient percentages, and no manufacturer can afford to furnish individual dynamos of other than standard winding.

With a compact building and the dynamo centrally located, the question that usually arises is not how to deliver the current at full pressure, but how to get the feeders small enough for the "drop" without heating. But with a plant that is a little too large, 5 per cent. is too little; 10 per cent. too much for economy; and so on. The man who has not longed for a dynamo "between sizes" has not been long in the business.

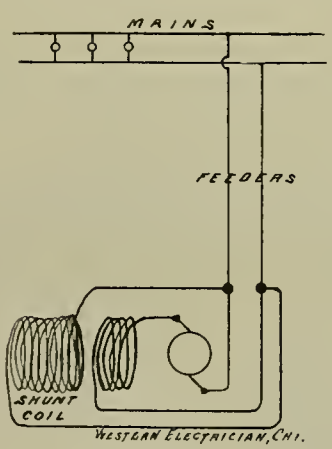


FIG. 2. CONSTANT POTENTIAL WITH OVER-COMPOUNDED DYNAMOS.

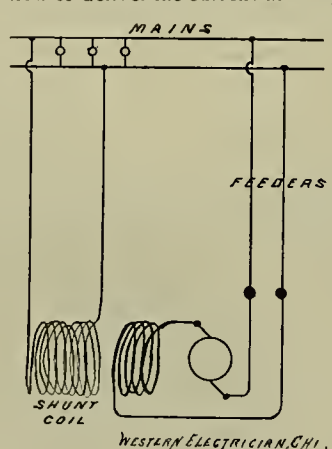


FIG. 3.

Take the shunt of a standard over-compounded dynamo off its terminals, and connect on the mains. You will find the machine is still over-compounded, but to a percentage about half what it was before. So the 5 per cent. will become 2½, and the 15 per cent., 7½. This suggestion is dedicated to the long-suffering expert who has had to run feeders up-stairs and down again "to work off that 5 per cent.," in the hope that it will be a small mitigation of his ever numerous sorrows.

Brooklyn Electrical Society.

The promise of the tentative meeting held two weeks ago at the Brooklyn Institute for the purpose of organizing an electrical department has been more than fulfilled, and the main hall of the Institute building was crowded on the 21st inst. to discuss further steps and to hear the first lecture of the series which has been arranged. Prof. Samuel Sheldon was the lecturer, and his subject was "The Requisites of Good Batteries." A constitution was adopted which embodied provisions for systematic courses of lectures, accompanied by experimental demonstrations on electricity and its application in the arts and sciences; a laboratory equipped with instruments of precision for electrical measurements and for the other apparatus necessary for the study by experiment and research of electric and magnetic phenomena; and the establishment of a course of lectures for the presentation and discussion of electrical questions. The following standing committees, each consisting of five or more persons, will be elected on nomination by the executive committee: 1. Committee on electrical standards and measurements; 2. on laboratory and apparatus; 3, on electric lighting; 4, on electric motors; 5, on telegraph and telephone; 6, on electro-metallurgy; 7, on the applications of electricity in surgery and medicine.

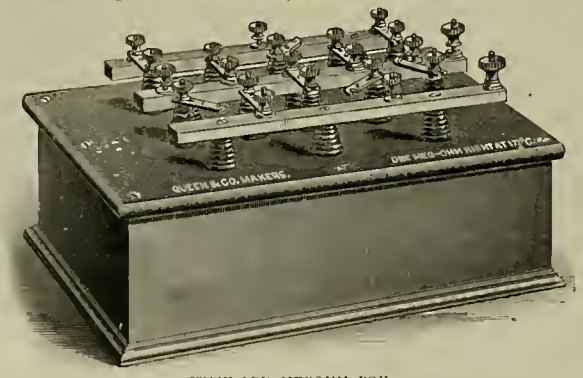
Prof. Hooper, who was elected to the chair, stated that Prof. Robert Spicer had promised to deliver a gratuitous course of lectures on electrical measurements. These lectures have already been given at the Cooper Institute before large audiences. Another most interesting statement made by the chairman was that the new department would not only start with a membership of over 150, but had been already provided with the means of fitting up its laboratory by the munificent gift of Dr. P. H. Van der Weyde, of his entire electrical apparatus, consisting of over 500 pieces, and valued at several thousands of dollars.

Prof. Sheldon's lecture was a model of a clear, concise talk on the elementary stages of his subject, and all his experiments were striking and effective.

The Standard Megohm Box.

The rapid growth of electric lighting and the consequent competition of manufacturing companies has necessitated the closest attention to the smallest details of installation. The close interest displayed by the public has also compelled the adoption of all accessories tending to greater safety in operating plants and central stations. One of the greatest sources of peril is well known to be poor insulation, and high insulating qualities are now almost the prime desiderata among makers of electric light wires. The most careful measurements are taken by them and used as evidences of the greater or less value of any particular brand.

In making reliable instruments of this kind one of the most essential requisites is a first-class and accurate standard of high resistance. The megohm box shown in the accompanying cut has been especially designed so as to prevent all leakage while measurements are being made. The coils are 40 in number, each of 25,000 ohms' resistance, and are united in sets of four. The terminals of each set of four coils are mounted upon corrugated rubber pillars, very highly polished, an inch and a half high, the corrugations making the pillars equivalent in insulating surface to pillars 3 inches high. The rods passing from these outside terminals to the extremities of the coils within the box do not touch the rubber pillars except at the top, the pillars being cut away inside for that purpose, so as to inclose the rods without contact. The binding posts or terminals may be so connected, by means of the metal straps, as to throw any number of the coils together in series or in multiple. The coils themselves are wound of platinoid wire and adjusted by Prof. Wm. A. Anthony to the highest degree of precision, while the mechanical finish throughout is of the very best. The megohm box is manufactured by James W. Queen & Co., Philadelphia.



STANDARD MEGOHM BOX.

Mill Tramway at Lawrence, Mass.

Conclusive proof of the fact that electricity can be used to advantage for mill tramways is shown in the accompanying illustrations of the installation at the Washington Mills, Lawrence, Mass., which has recently been completed by the Thomson-Houston Motor company. The tramway is used exclusively for carrying coal from the coal pockets to the boiler room, a distance of about 400 feet. The track is level the entire length, and for the most part straight, there being but two curves: an S-curve just after leaving the coal pockets, and a similar

ELECTRIC MILL TRAMWAY.

one through a less sharp turn where the track enters the boiler house.

In the electrical construction the overhead system has been used, brackets being employed to support the trolley wire, which runs in height from 12 feet where all is clear, to 6 feet where the track passes underneath a belt box between two of the mill buildings, the springs on the trolley arm being so adjusted as to maintain an even pressure of the trolley against the conductor, irrespective of its height. The current for the operation of the motor car is supplied from a 110 volt dynamo which is used for mill lighting, the rails and a supplementary ground wire being used for the return circuit.

The car equipment consists of one ordinary dump coal car, and one platform car provided with one three-horse power 110 volt series wound motor geared to the car axle, capable of developing sufficient power to haul a load of 5,000 pounds, at the rate of six miles an hour. At one end of the car are placed two levers, one for the special type rheostat used for governing the motor, the other for the reversing switch. Both of these as well as the brake handle are under the immediate control of the operator, who stands upon the platform in front. The floor of the car is made so that it can be readily removed to allow an easy inspection of the motor and appliances, which, though covered with a thick coating of coal dust at all times, have not failed to operate satisfactorily since the tramway was first put in operation.

The Storage Battery Motor Company.

The Storage Battery Motor company has recently been incorporated with headquarters in Chicago. Its officers are as follows: President, F. E. Hinckley; vice-president, G. H. Gale; treasurer, G. M. Greenebaum; secretary, H. T. West. This company, which recently secured the patents and property of the Woodward Electrical company of Detroit, has purchased a tract of ground at Hermosa, on the C., M. & St. P. railroad, just outside the limits of Chicago. There are several fine manufacturing buildings on the ground and the company now proposes to remove the entire plant of the Woodward Electrical company from Detroit to this location. It also has secured a number of valuable patents on motors and gearing, and proposes to push the manufacture of storage batteries for traction as well as for lighting purposes. In a short time it expects to have several storage battery cars running on street car lines in Chicago. For a couple of weeks past it has had a car in successful operation at Pullman, Ill. It is intended to bring this car up to Chicago within a few days, and test it on several street car lines.

Tests of Alternating Current Arc Lamps.

In the last issue of the WESTERN ELECTRICIAN there was presented an interesting account of a number of alternating current motor tests which were made by a commission of experts appointed by the municipal authorities of Frankfort-on-the-Main, Germany. The commission also experimented on alternating current arc lamps. An abstract of their report, which is taken from the London *Electrical Review*, is as follows: In opposition to the numerous and very contradictory assertions as to the difference in quantities and the distributions of light given by alternating current and continuous current arc lamps, the commission carried out some experiments so as to obtain a fairly accurate and practical value for the proportion of the mean special illumination of the two kinds of lamps. Accurate photometric determinations of the intensity of the light emitted by both kinds of lamps in different directions would have required more time than was at the disposal of the commission.

In order, therefore, to determine the illuminating effect of both lamps for rooms, there were fitted up two contiguous shops, equal in size, alike in shape, and of the same color within and provided on the north side with two show windows each. One of these two spaces was lighted up with a Schuckert continuous current arc lamp, and the other with an alternating current arc light by Ganz & Co. Each lamp was suspended at the same height from the middle of the ceiling.

These lamps were set in normal action, care being taken that both, inclusive of the so-called "steadying resistance," consumed almost exactly the same electrical energy. The Schuckert lamp worked with 5.8 amperes and 56.3 volts tension at the terminals. The Ganz lamp consumed on the average 330–335 watts, with a current of 8.1 amperes. While three observers read off the data needed for calculating the energy consumed in both lamps, the five members of the commission, each independently, valued the proportion of the luminosity of the two shops, comparing the two west sides, the two south sides, the two east sides, the two ceilings, and the two floors, each surface being repeatedly compared by each observer. The mean proportion of illumination of the five pairs of surfaces compared could, therefore, be taken approximately as the proportion of the mean special illumination of both lamps. As the luminosities to be compared did not differ greatly, and as the majority of the observers had acquired experience and accuracy, by frequent photometric practice, in valuing differences of light, it was to be expected that their conclusions would not differ very widely from each other.

In these observations it was found that the small alternating current lamps did not give so white a light as the small continuous current lamps.

With alternating current lamps for stronger currents this difference did not appear.

The conclusion of the five observers was that the mean special illumination of the alternating current lamp was to that of the continuous current lamp as 1:1.23 (approximately as 4:5).

The lamps used in these trials had been supplied respectively by the firms—Schuckert & Co. and Ganz & Co., who had been requested to construct their lamps normally, and who declared at the close of the trials that the lamps had burnt normally during the whole time.

For examining the open air effect of the two kinds of lamps four high masts had been erected at the corners of a square plot of level ground, each mast supporting a lamp. The two southern masts carried alternating current lamps by Ganz & Co., and the two northern masts continuous current lamps by Schuckert & Co. The height of the lamps from the area to be illuminated was arranged according to the instructions of both firms.

In the experiments the four lamps were regulated in such a manner that they consumed the same electrical energy between their terminals. The Schuckert lamp, worked with 11.8 amperes, and a tension at the terminals of 55 volts, consuming, therefore, 650 watts. In order to bring the consumption of energy of the Ganz lamp to the same level it had to be fed with a current of about 16.4 amperes. After thus obtaining an equal consumption of energy, the attempt was made to value the mean difference of the illumination of the ground by the two kinds of lamps, as well as the circumstances permitted. According to the unanimous judgment of the commissioners, the mean illumination of the ground given by the alternating current lamp fell short of that of the continuous current lamp in the proportion of 4:5.

It appeared that, in order to consume equal energy, the alternating current lamp had to work with a strength of current in excess of that assumed as normal for the carbons, so that the above result is not directly applicable for calculating the illuminating effect.

In the above fact, and the further theoretical and practical considerations relating to the utilization of that moiety of the light which is radiated upward in the alternating current arc lamp, we may assume that for an equal expenditure of energy the brightness of the two lights is about as 4:3.

It was at once seen that in the alternating current arc lamp the chief emission of light does not take place horizontally; on the contrary, the horizontal radiation has the lowest intensity; and the distribution of light in the alternating current lamp differs from that in the continuous current lamp in the circumstance that in the latter almost the entire light falls downward at angles of 40° to 60° with the horizon, whilst in the alternating current lamp half the light falls obliquely upward and half obliquely downward. Thus, in an alternating current arc lamp, there exist two conical surfaces of maximum eradiation, the one downward and the other upward at approximately equal angles to the perpendicular.

Hence for an equal consumption of energy the performance of an alternating current arc lamp is less indoors by 20 per cent., and in the open air by 25 per cent.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

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THE fact that electricity will perform an important part in all kinds of mining operations is becoming generally recognized. The inventions in this department of electrical engineering are multiplying. In this issue appears the description of a new drill for use in coal mining, which presents several interesting features.

JUDGE COXE'S decision in the Brush-Julien storage battery litigation will be found on another page in this issue. The opinion is long and goes into the details of the claims of the patent alleged to be infringed. The plaintiff's patents claims are in the main sustained. Some of the probable results of the decision are noted in the New York letter.

IN the Kansas City letter is given an abstract of a paper read by T. F. Clohesy at a convention of representatives of insurance companies. His subject was that which provoked so much interest at the Kansas City convention of the National Electric Light association, the relation between insurance and electrical companies. He believed that insurance companies should enforce compliance with safety rules, and that with thorough inspection by competent men electric lighting plants and buildings where electricity was used for light or power would be classed as most desirable risks.

CHEMIST MARTIN of the New York Board of Health, made an important statement before the Senate Investigating committee last week in relation to the comparative dangers of electric lighting and gas. He says that 10 per cent. of the gas manufactured in New York escapes from the mains into the earth and permeates the cellars and basements of the buildings and residences throughout the city. In addition to the injurious effect this has on the health of the city, it is also manifestly evident that there is great danger to life and property through explosions which must follow the introduction of gas into sewers and subways. One thousand million feet of gas contains more danger than the electric conductors in New York city, yet this is the amount that leaked from the mains of the gas companies of that city last year.

A STENOGRAPHIC report of the discussion of Dr. Louis Bell's paper on "Electric Motors in General Railway Work," which was read at the last meeting of the Chicago Electric club, is given in another column. It will be remembered that Dr. Bell stated his conviction that electricity would eventually come into very extensive use in general railroad work. In the discussion of the paper the majority of the members expressed belief in the truth of the prediction. The most important point brought out, and one it may be remarked, often not realized apparently, was the fact that electricity is simply an agent, and that the question of the adoption of electric motive power is after all a question between large stationary engines working at the highest economy, and comparatively small locomotive engines operating at a less economy, taking of course into consideration the loss in transmission.

IN an article recently read at the Chicago Electric club on the theory of compounding dynamos for constant potential, it was pointed out that there exists a disturbing factor in the calculation of the value of the series winding in an over-compounded dynamo as ordinarily connected. This factor, it was shown, was the value of the shunt coil. From the fact that the magnetic influence of this winding changes in such a machine, necessarily with every variation in e. m. f. at its terminals, the supplementary winding cannot be calculated without allowing for this increased effect. It is, therefore, most desirable to eliminate this variable. In an article printed elsewhere in this issue, entitled "Constant Potential with Over-compounded Dynamos," a method is described by which such a result may be brought about in an exceedingly simple manner. The method is worthy of the consideration of practical men.

IN AN able editorial on the copper question the New York *Times* refers to the action of the electric interests in pressing this question upon the attention of Congress. Here is an abstract: "There are many reasons why even a republican and protectionist congress, with the extremest views as to the beneficence of taxation as a source of national prosperity, should promptly and eagerly grant this modest prayer. Indeed, if the republicans could pry their eyes open wide enough to see the signs of the times that lie just beyond their noses, they would not wait to be asked to take such a step. There is not the shadow of an excuse for a duty on copper. If there ever was one, and that is not true, it has long ceased to exist." The *Times* continues its editorial as follows, speaking of electrical interests: "The fact cannot be disputed that the tax on copper is a tax on the safety of human life, and that its repeal is as much demanded by reason and justice as the abatement of any other dangerous nuisance maintained for the profit of a limited number of persons."

ELSEWHERE in this issue is presented an account of a number of comparative tests with alternating and continuous current arc lamps. The experiments were made in Germany for a well-known municipality by a commission of experts, to obtain a fairly accurate and practical value for the proportion of the mean special illumination of the two kinds of lamps. In view of the fact that the alternating current arc lamp is now being exploited on this side of the water, and that as yet our electrical engineers have had, necessarily, but a limited practical experience with the system, the report will be of considerable interest. In making the test the commission compared the intensity of light emitted by an alternating current arc lamp and a lamp supplied by a continuous current. Care was taken that both lamps consumed almost exactly the same electrical energy. The conclusion of five observers was that the mean special illumination of the alternating current lamp was to that of the continuous current lamp as 1:1.23. The difference in the distribution of light from the two lamps, however, was also pointed out and in forming a conclusion after a perusal of the report, this difference should be borne in mind. While the commission acknowledges that accurate photometric determinations were not made, the reader will appreciate that the commission went deep enough into the matter to give the results a value to practical electrical engineers.

IT IS not a surprising fact that the New York Court of Appeals has sustained the electrical execution law. Few persons have anticipated that the court of last resort would overrule the decision of the General Term. An abstract of the finding of the Court of Appeals is given in another column.

The court disposes of the assertion that the method of execution was cruel, in this way: "Whether or not electricity is more humane was a question for the legislature alone to determine, and they had more chance of so determining than any appellate court. The decision of the legislature is conclusive upon the courts." The conclusion of the court in brief is given in these sentences from the opinion: "The court finds that the mode proposed is not cruel within the meaning of the constitution, though unusual. On the contrary, all agree with the court below, that it removes every reasonable doubt that the application of electricity to the vital parts of the human body under such conditions and in the manner contemplated by the statute must result in instantaneous and consequently painless death."

There seems to be no reason to doubt that Kemmler and other murderers now awaiting punishment in New York state will be executed by the application of electricity. The enactment of the law was we think, the greatest of mistakes. We question greatly whether in actual practice the new method will prove more humane than hanging. If the apparatus is properly handled very likely it will do the work for which it is intended, but if manipulated by persons who do not comprehend its operation, electricity may cause the victim the greatest suffering. It seems to us that only the best of electricians should be trusted to handle electrical machinery at executions, but of course their services cannot be secured. An ordinary individual does not covet the position of Jack Ketch. It is for just this reason that the passage of the law by the legislature was extremely ill-advised. There is not now a competent electrician in the country who is willing to sacrifice his reputation by becoming an executioner. It looks now as if the apparatus would be handled by bunglers, and if so the legislative purpose of providing for more humane executions is not very likely to be accomplished. And here another objectionable feature of the law is met. How are we to know whether the new method is successful, as the law provides that no details of execution shall be published? The luckless victim may suffer every torture that a blundering electrician may inflict, and yet under the law no one will be the wiser. The law is tyrannical and as a contemporary says, is perhaps the most offensive legal provision in the books in New York

At the Kansas City convention of the National Electric Light association the matter of electrical executions was brought to the attention of delegates by the committee on state and municipal legislation. The association voted to instruct the committee to co-operate with the New York State association in order that an amendment to the law might be adopted providing that special electrical apparatus should be built for use at executions. It is to be hoped that the committee will eventually succeed in securing the construction of special apparatus, though the prospect at the present time is not encouraging.

Brush Company vs. Julien Company—Decision of Judge Coxe.

Appended is an abstract of Judge Coxe's decision, handed down March 18, on the storage battery suit of the Brush Electric company against the Julien Electric company. The history of the case is given at the outset of the decision, as follows:

This is an equity action for the infringement of four letters patent, granted to Charles F. Brush for improvements in secondary batteries, and now owned by the complainant. These patents are dated and numbered as follows:

Nos. 337,298 and 337,299 were applied for June 13, 1881, and were granted March 2, 1886. No. 260,654 was applied for June 13, 1881, and was granted July 4, 1882. No. 266,090 was applied for June 9, 1881, and was granted October 17, 1882.

The first of these, No. 337.298, which is distinguished as Case I, relates to secondary batteries and consists in a plate or support, provided with a mechanically applied coating of absorptive substance adapted to be transformed into an active coating; also, in a plate or support provided with a mechanically applied coating of granulated, spongy or porous metallic lead. It further consists in the method of constructing plates for secondary batteries, consisting in mechanically coating lead, or other suitable plates, with an absorptive substance adapted to be transformed into an active coating. The drawings attached to the specification represent the supports in various forms. They show plain, studded, honeycombed, corrugated and ribbed plates; plates with angular corrugations, arranged singly or in pairs, and plates with slots or perforations extending through the plates. The active material consists of granular, porous or spongy lead, which is held in position upon the plain plate of lead by a sheet of heavy paper, cardboard, cloth or felt, which may be secured to the plate by rivets, ties, or binding strips of wood or metal. The paper or felt may be dispensed with and the spongy lead held in position on both sides of the support by subjecting it to pressure, hydraulic or otherwise. In the corrugated grooves, ribbed, perforated, studded, or cellular plates, the spongy lead may be held in the grooves, cells or cavities by paper or felt, or it may be rammed or pressed into them.

The specification states that "When a pair of plates are associated together to form a secondary battery, and immersed in dilute sulphuric acid and charged by the passage of an electric current in the usual manner, one of the plate absorbs a large quantity of hydrogen, while the other plate has its spongy or granular portion peroxidized, and thus forms the oxygen element of the battery."

The claims alleged to be infringed are the first, fifth, eighth, tenth and eleventh. They are as follows:

"1. A suitable plate or support, provided with mechanically-applied absorptive substance and adapted for use as a secondary battery element or electrode after being rendered active by an electric current, substantially as set forth.

"5. An improvement in the construction of a secondary battery element or electrode, said improvement consisting in a plate or suitable support, provided with grooves, receptacles, or perforations primarily coated, combined, or filled with mechanically applied absorptive substance, substantially as set forth.

"8. In the process of making plates or elements for secondary batteries, primarily and mechanically applying or combining with a suitable plate or support an absorptive substance adapted to be transformed into active material, substantially as set forth.

"10. In the process of making a secondary battery plate or element, combining by means of pressure an absorptive substance and suitable material to form a support therefor, substantially as set forth.

"11. In the process of making a secondary-battery plate or element, constructing a suitable plate or support, with grooves, cells, receptacles or perforations, said plate or support having an absorptive substance primarily applied thereto or combined therewith, substantially as set forth."

The second, No. 337,299, which is distinguished by the inventor as Case J, is for the same invention, substantially, as Case I. The drawings of the two are identical and the language of the specifications is very similar; where it differs, equivalent expressions are employed.

Perhaps the principal differences are the substitution of the words "active material" for the expression "absorptive substance adapted to be transformed into an active coating," of Case I, and the words "lead oxide" for the "granular or porous lead," of Case I.

The specification in question contains this additional statement:

"Peroxide is the best oxide of lead to use in the preparation of the plates; but as this is rather expensive to prepare, red lead or minium may be used. Some sulphate of lead is liable to be formed when this oxide of lead is employed, by the action of the sulphuric acid of the battery on it before peroxidation or reduction is effected. Protoxide of lead or litharge may also be used, but is objectionable on account of the large quantity of sulphate of lead which is unavoidably produced by the action of the acid."

And also the following:

"I would have it understood that I do not restrict myself to any particular form of active or absorptive material, or to any particular method of applying it to or combining it with the plate or support, as my invention consists, broadly, in a secondary battery plate or element having active or absorptive material primarily and mechanically applied thereto or combined therewith, as contradistinguished from a plate or element having the active material produced by the disintegrating action of electricity, as in the well-known Plante process."

The claims alleged to be infringed are the first, second, third, sixth, seventh, eleventh, twelfth and thirteenth. They are as follows:

"1. A secondary battery element or electrode, consisting of a plate or suitable support, primarily coated or combined with mechanically-applied active material or material adapted to become active, substantially as set forth.

"2. In a secondary battery, an electrode consisting of a plate or support, provided with a coating or surface layer of an absorptive substance, such as metallic oxide, applied thereto, substantially as set forth.

"3. A plate or suitable support primarily coated or combined with mechanically-applied oxide of lead, or equivalent lead compound, substantially as set forth.

"6. A plate or suitable support, provided with grooves, perforations or receptacles and primarily coated, combined or filled with mechanically-applied active material or material adapted to become active, substantially as set forth.

"7. A plate or suitable support provided with grooves, perforations or receptacles, and primarily coated, combined or filled with mechanically-applied oxide of lead, or equivalent lead compound, substantially as set forth.

"11. In the construction of secondary-battery elements or electrodes, a plate or suitable support primarily coated or combined with mechanically-applied red lead, substantially as set forth.

"12. The method of making plates or electrodes for secondary batteries, consisting in primarily combining active material with suitable plates or supports mechanically, in contradistinction to forming the active material by an electrical disintegration of the plate or support, substantially as set forth.

"13. The method of making plates or electrodes for secondary batteries, consisting in coating the plates or supports with red lead prior to their immersion in the battery fluid, substantially as set forth."

These two patents, Nos. 237,298 and 237,299, are fundamental patents designed to cover the broad inventions of Mr. Brush.

No. 260,654 is a division of Case J and is distinguished by the inventor as Case J, Division A.

The invention "consists in the method of making the plates of a secondary battery, consisting in forming receptacles for oxide of lead in its surface, then applying oxide of lead to the plates, and within such receptacles and afterward subjecting the oxide of lead to pressure."

The drawings of this patent are identical with those of the preceding patents, except that Fig. 1, showing the use of card board or felt, is omitted.

The specification contains the statements above quoted from Case J, relative to peroxide being the best oxide of lead to use, and says, further, that the oxide of lead may be retained in place by being rammed or pressed into its receptacles, cells or grooves.

The single claim is as follows:

"The method of forming the plates of a secondary battery, consisting in forming receptacles for oxide of lead in its surface, then applying oxide of lead to the plate and within such receptacles, and afterward subjecting the oxide of lead to pressure."

In No 266,090, distinguished as Case C, the invention consists in a secondary battery element, constructed of cast lead, or other suitable substance, having cells, receptacles, ribs, or projections on its surface, whereby an extended surface of metal is exposed to action.

The drawings are the same as those attached to the preceding patents, with some new ones added, showing the plates arranged ready for charging.

The specification says of Fig. 4 that it shows a modified form or ribbed plate resembling an ordinary window blind with the slats open. It may also be regarded as a thick plate perforated with a series of parallel slots. And of Fig. 5, that it shows the honeycomb form of plate, resembling in construction a simple or double comb of beeswax. It may have its cells extending entirely through the plate.

The plates may be made by pressing plain sheets of lead, or other suitable metal, into dies or forms by hydraulic or other means; also by slotting, punching or otherwise perforating suitable plates, and also by casting the melted metal into suitable moulds.

The claims alleged to be infringed are the first, third, fourth, fifth, sixth, seventh, eighth, ninth, twelfth and fourteenth. They are as follows:

"1. In a secondary battery, an element or electrode made up of a series of ribs, substantially as and for the purposes set forth.

"3. A secondary-battery element or electrode, having its body support or frame provided with ribs.

"4. In a secondary battery, the combination, with one cell thereof, of two or more ribbed plates or elements, substantially as set forth.

"5. In a secondary battery, a plate, frame, or other sustaining body provided with ribs or their equivalent, of a less general thickness than the said plate or support, substantially as set forth.

"6. In a secondary battery, a plate, frame, or other sustaining body, provided with ribs or their equivalents, said ribs or their equivalents being thicker at their bases than at their free edges or ends, substantially as set forth.

"7. A secondary battery element or electrode, having its frame, support, or body provided with cells or cavities, the walls of said cells or cavities, or the septa between them, having an increasing thickness from their outer or free edges inward.

"8. In a secondary battery, plates or elements, provided with comparatively thin ribs, or their equivalents, for surface-exposure, and thicker ribs, suitably disposed for supporting or stiffening purposes, substantially as set forth.

"9. A secondary battery having a body frame or support of cast-lead.

"12. A secondary battery element or electrode having a supporting body or frame of cast-lead for the active coating or substance, said body or frame provided with ribs or projections.

"14. A secondary battery element or electrode having a supporting body or frame of cast-lead for the active coating or substance, said body or frame provided with slots, perforations, or openings."

The defendants have made, used and sold secondary or storage batteries composed of a series of electrodes consisting of a cast metal support plate, 96 per cent. being metallic lead, and an exterior spongy or porous coating of mechanically applied active material consisting of lead oxides. These electrodes are placed in an electrolyte of dilute sulphuric acid in water. The charging current converts the lead oxide coating upon the oxygen plates into peroxide of lead and reduces the lead oxide coating upon the hydrogen plates to the condition of spongy or porous metallic lead. The battery is capable of numerous charges and discharges, in the course of which the active material undergoes successive reductions and reoxidations. The lead oxides used consisted generally of minium and litharge, the former largely predominating in the mixture applied to the oxygen plates and the latter predominating in the mixture applied to the hydrogen plates.

The defenses to all of these patents are anticipation, want of novelty, lack of invention, abandonment (except of No. 260,654) and that the claims have been fatally broadened. As to Cases I and J it is said that the scope of the original applications has been unlawfully enlarged; that the patents expired with an Italian patent to Brush containing the same invention, and finally that they are for the same inventions, and that one of them is, therefore, void.

It is also insisted that No. 266,090 is limited by the Italian patent. Invalidity and non-infringement of several claims are alleged.

Are Cases I and J for the same invention, and if so, what coarse should be pursued regarding them? It will simplify the controversy to answer this question at the outset.

Judge Coxe reaches this answer to the question he has propounded:

There can be no question, if "absorptive substance" and "active material" are equivalent terms that these claims are for the same invention. Each has the following elements: (1) A secondary battery support plate (2) mechanically coated with (3) an absorptive or active material.

The question, then is can a patentee who has received a patent for a plate coated with absorptive substance obtain another patent for the same plate coated with active material? Can an inventor obtain two patents for a broad invention because in one he practices the invention with one substance, and in the other, he practices it with an equivalent substance? Manifestly not.

After Case I no one else could have had a patent for Case J, even if confined solely to the points wherein the two are said to differ. The former includes the latter. I am constrained to say, therefore, that the two patents are, in legal contemplation, the same. Although the possibility that the court might reach this conclusion was stated at the argument, neither counsel offered any solution of the difficulty and none has been offered since. The situation is, certainly, an unusual one. Here are two patents for the same invention applied for at the same time and granted at the same time. It is true that no injury can result in this particular instance, but what would be the situation if one of these patents were owned by a third party and a suit were brought on it against the defendants for the same infringement, or if the second patent were granted years after the first? If the principle is once established that an inventor can by such inconsequential changes, as here are shown, obtain two patents for the same invention, the greatest injuries may be done, both to competitors and to the public.

It would seem that as the inventor has given Case I the preference and as his expert regards that as the broader of the two patents the difficulty might be met by a surrender of Case J, or perhaps, by a disclaimer of similar claims in Case J, leaving those which have not been brought into controversy or considered, and possibly, the red lead claims, to stand. But, as neither counsel has expressed his views on this subject, the method of carrying out the opinion of the court can best be arranged on the settlement of the decree.

The claims of what Faure and Brush accomplished are referred to and Judge Coxe answers the question, "What did Brush accomplish?" as follows:

In brief, it is this: In the summer of 1870 he made secondary battery electrodes by applying to suitable plates an active or absorptive coating consisting in three instances respectively, of metallic lead in the form of fine powder, red oxide of lead, and litharge These coatings were held in place by a piece of blotting paper, a strip of wood and a string wound tightly around the whole. In July, 1880, he made lead plates with deep grooves; into the grooves of some he rammed yellow oxide of lead, and in others sulphate of lead. In September, 1880, he made six plates grooved by a gang of circular saws and filled the grooves of two by ramming them full of litharge, and two of others by ramming them full of sulphate of lead. The electrodes thus constructed operated successfully in secondary batteries and produced satisfactory results.

Many other structures leading up to the invention were made, but it is not necessary to consider them in detail. It may be said, however, that from the time the idea first entered his mind until the applications were filed Mr. Brush was engaged almost constantly, in progressive experiments and investigations.

For the reasons stated in the *Accumulator Case* it is thought that this invention is not anticipated by the testimony of Professor Van der Weyde, the article from the *Electrician*, the Smithsonian report, the Grove battery or the patents to Kirchof of Pulvermacher, (39 Fed. Rep. 490).

On the question as to whether the Percival battery patent 53,666 granted in 1886 was an infringement, the court says there is no evidence that a Percival battery was ever used or could be made operative. His invention does not seem to be on the line subsequently followed by Brush. He has no plate or support at all resembling those of the Brush patents. He has no *coatings*. His two copper connecting slips *support* nothing. The pulverized gas carbon is not mechanically applied to them; they are simply in contact with the gas-carbon. Their presence is not necessary; they are put there for greater convenience only. Percival's electrodes are not coated supports at all; they are cells filled with coarse conducting powder, and divided by a porous partition.

Further, the court says of Mr. Brush's work:

It would seem then that nothing in the record anticipates the Brush patent, Case I, when a construction commensurate with the invention is placed upon it. He did not invent secondary batteries, or electrodes for such batteries having a layer of active material, or the use therein of a conducting powder, but he seems to have been first, in this country, who held the absorptive substance, in the form of dry powder, in place on the supports by paper or equivalent material, and the first who rammed or pressed it into grooves or receptacles in the plates.

The court finds that the invention of Case I was not abandoned, and adds:

It is thought no authority can be found holding an invention abandoned upon such facts as are here developed. I should be sorry to make a precedent now which can have little but the most technical reasoning to support it.

The question whether claims 5 and 11 of Case J have been unlawfully expanded by the insertion of the word

"perforations" is answered in the negative. Judge Coxe's conclusion is as follows:

It is true that the ordinarily accepted meaning of the word "perforation" would imply an opening extending entirely through the plate, and such an opening the inventor could not engraft upon the original application. But the word may also have a meaning synonymous with "cavities or cells;" it may mean a hole not passing entirely through, but into the center or interior, and a plate with such perforations the inventor was at liberty, it would seem, to claim under the original application.

Such a construction does not interfere with the rights acquired by the public for it does not permit a broadening of the claim. It holds the inventor strictly to what he asked for in the first instance.

When, by a liberal construction, a patent may be sustained, is it not the duty of the court to adopt it rather than one which, though possibly more plausible, will deprive the patentee of the fruits of a meritorious invention to which he is fairly entitled?

With considerable hesitation I shall hold that these claims, as thus construed, are valid. That they are infringed there can be little doubt. The defendants, electrodes have receptacles; they may be improved receptacles, but they are receptacles nevertheless. These claims do not cover the improvement.

In reference to the claims for pressure on making storage battery plates the court says there can be no doubt that a construction as broad as here demanded would invalidate the claims. It would cover a well-known and exceedingly simple operation. It would cover the mechanical application of the coating. It is hard to conceive how it could be made to adhere without some degree of pressure. Even the blotting paper, stick and string of the 1879 electrode would infringe. Pressure such as this, it is believed was not contemplated by the inventor. He had in view pressure, plus the mechanical application, by means of which the coating would adhere more perfectly not only, but by which better conductivity could be obtained.

But if the narrower construction is given these claims the defendants do not infringe; at least they have not been proved infringers.

Case C, No. 266,090, contains two classes of claims. The first class (claims 1 to 8 inclusive) relate to the form of the plates, the second class (claims 9, 12 and 14) to the material of which the plates are formed. Claim 7 relates to a secondary battery electrode having its support provided with "cells or cavities." The other claims of the first class relate to "ribs." Claim 14, in addition to the element of cast lead, has also the element, not elsewhere claimed in this patent, of "slots, perforations, or openings."

The court says of these claims:

The defendants use a support filled with rows of uniform square holes. The court is not prepared to say that the walls between these holes are ribs. The ordinary meaning of the word would have to be strained and distorted to make it cover the "partitions or septa between the cavities," and especially so in an art where a restricted meaning is required. A careful reading of the specification confirms the impression that the patentee intended to use the word, not as now asserted, but in its ordinary sense, as synonymous with projections or ridges. He intended to draw, and does draw, a sharp distinction between plates with ribs and those with cells, cavities and perforations.

Claims 9 and 12 are clearly void for want of patentable novelty. Their only distinguishing feature is cast lead. The complainant, if its position is correctly understood, does not assert that there is anything patentable in casting lead. It is not alleged that the eleventh claim, which covers the process of casting, is infringed. Not only every skilled mechanic, but every school boy who has experimented with molten lead, who was shown a model of defendants' grid, and asked to make a series of them would at once suggest the idea of casting them in moulds. * * * * What, then, is the novelty upon which these claims are sought to be sustained? It would seem to rest solely on the theory that cast lead produces better results on a secondary battery than rolled or pressed lead. A patent cannot stand, for a moment, on ground so narrow.

Claim 14 may be construed as covering a combination one element of which, the slots, etc., is new and useful, and is not covered by the other claims. Regarding the infringement of this claim and claim 7 there can be no doubt and the same is true of the claims, in controversy, of Case 1.

Judge Coxe then discusses the questions arising on the expiration of the Italian patent. His conclusion is:

It should be remembered that we are dealing here with a mysterious and occult power of nature, the science of which is still in its infancy, the phenomena of which are but little understood, even by those who have made its study their life work. For one who has but a casual and superficial knowledge to place a construction upon a patent which is addressed those who are educated in this department of science and which constantly employs terms of art, in opposition to the opinion of the only electrician who speaks upon the subject, would be unwarranted, especially when such a construction will destroy rights and interests of great value. In very many of the patent causes which come before the courts, where the device is so simple that any man of ordinary capacity can understand it, the presence of an expert is wholly unnecessary, but when the invention relates to a subject where even the pioneers are still groping in shadows, the court needs the instruction of those most competent to advise and without such assistance should proceed with the utmost caution. The law does not favor forfeitures. A patent should never be declared invalid because of the expiration of a foreign patent, if there is doubt about the inventions being the same. The burden is upon the defendants, and the doubt should be resolved in favor of the patent.

After such study as I have been able to give the subject, I am not satisfied that the Italian patent is for the same invention as those in controversy. It is sufficient, for present purposes, to state that the mind of the court is in doubt upon the question.

No. 260,654 is not, in any event, affected by the Italian patent. The former bears date July 4, 1882, the latter, August 8, 1882, and it was not applied for till July 28, 1882.

It follows that upon filing a disclaimer of the invalid claims the complainant is entitled to a decree in accordance with this opinion, but without costs.

In connection with this decision the following statement should, I think, be made:

A suit similar to this is pending against the Electrical Accumulator company. Sometime after the oral argument in this cause was concluded, the counsel for that company after due notice to all parties interested, called the attention of the court to the following facts:

On the 28th of March, ten days after the decision on the Faure patent was filed, the president and the secretary of the Julien company, without the knowledge or consent of counsel, obtained from the complainant an option to take an exclusive license under the patents in suit, provided they were sustained.

In view of these facts the court was asked either to refuse to decide the cause altogether, or to postpone the decision until the cause against the Accumulator company is ready for argument.

The court urged upon counsel the importance of having the issues passed upon in a controversy which is in all respects, genuine and earnest, and expressed his own disinclination to decide an action where a suspicion to the contrary might exist. Several plans were suggested, but none on which counsel could agree. As a decision in the other cause will not be reached for a year, and as the option alluded to is not regarded as a settlement of the cause, the conclusion has been reached that justice to the parties demands that a decision should be made at this time.

Electric Motors in General Railway Work.

At the last meeting of the Chicago Electric club a paper by Dr. Louis Bell on "Electric Motors in General Railway Work" was presented. The paper was published in the last number of the WESTERN ELECTRICIAN. After the reading the following discussion took place:

MR. DELAND: We have with us this evening the chief engineer of the elevated road in this city who had a great deal to do with constructing the elevated lines in New York city. He was present when experiments were made with electric systems on the elevated lines. I think that Mr. Sloan can give us some interesting facts.

MR. SLOAN: I have been very much interested in the paper which has been read, and the figures are quite correct as to the proportion of coal consumed to the horse power generated. We think in New York, or did think when I left, that we could not get along without the locomotive. On the Third avenue line we have, between 5 and 6 o'clock in the evening, sixty-three trains in motion at one time. Each one of these trains consists of an engine and five cars. The cars are loaded to about twenty tons. The engines weigh twenty-three tons each. These five cars weigh 100 tons and they go up grades which are about 2 per cent. at the rate of about ten miles an hour. The rate of speed averages about fifteen miles an hour, including all stops. On the west side between the stations our speed is about twenty miles an hour.

I was present at the time Mr. Sprague made his experiments on Thirty-fourth street, and Mr. Daft made his on the Ninth avenue road. I was with Mr. Sprague when he ran one of our cars filled with people, the car and load weighing about nineteen tons, from Thirty-fourth street to Third avenue at twenty miles an hour on a very wet, rainy night. I asked him what power he had, and I think he told me about 1 000 volts. He has made no experiments since that time. Mr. Daft made several experiments. I understand that he is building a new motor which will have a greater weight on the drivers. There did not seem to be weight enough in his motor at that time to get the necessary tractive force. The stationary engine at Fourteenth street has developed 175 horse power, and he ran a train of four cars up to Fiftieth street, a stretch of 800 feet, over a 2 per cent. grade, at ten miles an hour. The cars were never filled with people. One car was filled and the other three cars were lightly loaded. He has made no experiments in the last four months. It was necessary, he thought, to have a copper wire of greater diameter than was then used. I think the one that he had was about five-eighths of an inch in diameter. I was much interested in his experiments, but he did not seem able to get up the speed. The train started off very nicely, and stopped at all the stations, but whenever it would start from the station there would be of course a great increase of horse power developed at the stationary engine; still there seemed to be difficulty in getting up the speed that we got up with the locomotive.

MR. BUCKLEY: I should like to ask the gentleman whether Mr. Daft came to the conclusion that the reason he could not get up his speed was because the motor was too light? Did he think that if he had a motor car of sufficient weight to get the necessary traction force, that he could get up the speed?

MR. SLOAN: I think that was his opinion. I think he is building a heavier motor now. On Third avenue we have 63 trains in motion at one time, and each train weighs 100 tons. I have often wondered how much power it would take, how much power it would be necessary to develop by a stationary engine to move all those trains at one time. Suppose you have a road five miles long, and you want to make that time in twenty-five minutes; you run your trains at two minute intervals. You have, say, twenty-four trains in motion at one time, twelve going up and twelve going down. I would like to know how much power would have to be developed at the stationary engine to move those trains.

MR. BUCKLEY: From Prof Bell's paper I should judge he would estimate in a hypothetical case, such as the one stated, that it would be necessary to allow about seventy horse-power for each train.

THE CHAIRMAN: Mr. Baker of the Daft company may be able to give us some information on this subject.

MR. BAKER: Most of these experiments on the New York elevated were made when I was away. I can only say that we have begun to construct a 250 horse power motor which is partially finished and is intended for use on the New York elevated.

MR. BUCKLEY: Do you know the size of the motor that Mr. Daft used?

MR. BAKER: It generated 128 horse power.

MR. DOW: It seems to me that the question of the adoption of electricity as a motive power is exactly a question between large stationary engines working at highest economy, and comparatively small locomotive engines. We have in practical use in lighting stations to-day, engines of twelve to fifteen hundred horse power with a fuel economy within two pounds per horse power hour. If the conditions would allow such engines to be used, and the power that they generate so economically to be transmitted to the motor without such loss as to nullify the economy, then the advantage is with the large engine, and with the electric motor.

We must look at it in the light that our electric arrangements are simply a method of transmitting economically generated steam power, and that the competition between the locomotive and the electric motor, is between the transmission of economical power to a distance with loss, and the generation of power not so economically or safely generated at the place where it is to be used. It is not a fight in favor of the large engine to-day, because there is a continual improvement in smaller engines. This last year has seen the introduction of high speed compound engines as low as 60 horse power, and 100 and 150 are being made and used right along, and are called for very frequently. The locomotive has been compounded and put exactly on the same level of economy as the stationary compound non-condensing engine for nine years past. I think the first compound locomotive that was put in regular use was the Webb locomotive on the London & Northwestern railway, which to my knowledge, was pulling express trains between London and Liverpool in the year 1882, possibly 1881. I don't know to what extent the use of that locomotive has extended. But I saw one of those same locomotives complete, with its English driver and fireman and English name-plate, in the Pennsylvania yards at Harrisburg about a year ago. I found that the Pennsylvania company was experimenting on the same principle. I was riding the other day on a Michigan Central express, and was told that the engine pulling it was a compound. The steam economy was something like twenty-three to twenty-four pounds of water under favorable conditions. Of course these locomotives have only been put on for continuous runs. A considerable portion of the capacity of the engine is developed for long periods, standing idle and chilling down the cylinders, being eliminated as far as possible. I do not know that we are looking at it as we ought to. We always keep forgetting, as electric light people, that the whole question ends in the coal pile, and that the electric motor is not the power, but it is simply a means of transmitting steam power economically generated.

MR. DELAND: I would like to ask Mr. Dow whether he can answer the question asked by Mr. Sloan, whether it would be possible with series or constant potential to operate on a five-mile circuit, that is a five-mile run, twelve trains going down and twelve trains returning, at intervals of two minutes, which Mr. Sloan spoke of.

MR. DOW: Mr. Sloan's question referred to sixty-three trains in motion at one time on the line. He asked, I think, how many horse power it would be necessary to generate at the station for that purpose. I take it that the figures he has given us allow for such a number of trains as will be starting at the same time, consequently calling for the highest horse power. If I am right we would have sixty-three multiplied by seventy-five as the amount of horse power to be delivered. We must add the amount of horse power expended in transmission; and add to that the friction of our generating plant. Then we have the amount that we must show in our indicator diagram for the steam plant. There is no trouble whatever in getting a stationary engine that will develop 10,000 horse power. It is done every day in marine work; the Etruria, the Normandie and others having engines which indicate 10,000 horse power. They work on the steamship very economically. Such engines could be set up in New York and be operated just as cheaply as these vessels at sea. The question would then be between the relative economy of a cheap development of power, plus the loss in transmission, and a comparatively expensive development of power without the item of loss in transmission added. To cover five miles with such enormous horse power would entail a tremendous transmission loss. It seems to me from my recollection of the New York elevated railroads that one station could be arranged in the south end of town to handle a number of diverging lines. The total length of lines operated by that station might be five miles, and yet the distance to the furthest point not be very great. In a long straight line, such as the uptown lines are, with sixty-three trains put on five miles, the transmission loss would be considerably greater.

MR. SLOAN: I would like to ask the gentleman how much wire he would have to have?

MR. DOW: It depends on the power you can afford to expend in transmission. If two pounds of coal are required for your stationary engine, and six pounds for your locomotive, then you can afford very well to operate on 50 per cent. efficiency, and use comparatively small wire.

MR. SLOAN: Where does this great loss of power occur?

MR. DOW: From the time it leaves the engine cylinder. Our indicator diagram shows the amount of power devel-

oped in the engine cylinder. The first loss is the friction of the engine itself. That is the amount of power required to keep that weight of metal in motion. The second loss is usually the slippage of belts. The third loss is usually the power required to keep the counter shafting in motion. The third loss again is the slippage in dynamo belts. The fourth loss is the conversion loss, as we call it. It may be ten per cent. with modern dynamos. The fifth loss is usually in a long distance system, the loss of all losses, that is to say, the amount of power required to pump that amount of current through so many miles of copper mains. The loss is directly proportional to the length of the mains, and inversely proportional to the size of the copper. That is, the distance you go increases your loss as the distance, and what money you can afford to spend for copper brings down your loss. I would point out that it would be economy to develop twice the horse power required for these elevated roads at two pounds of coal per horse power, and to spend one-half of the power developed in transmitting it to the motors, making a total cost for effective horse power at the motors four pounds per horse power as against six pounds now required. That is where the economy would come in.

MR. COOK: Mr. Chairman, I fear that I can add nothing to the discussion. My information in regard to motor railroad engineering is very slender, but it has gained by what I have heard to-night. It seems to me that the paper is very conservative and contains a well-informed statement of the position of motor service in railroad work. It does not seem to me a partisan statement at all, but a statement of one who is well informed. I know that Dr. Bell has done some very careful testing of motor systems, and I think he has made some of the best tests so far in practical electrical railroad work. I have just taken the figures that have been given us in regard to the horse power required for the sixty-three trains, and I make it 9,450. Of course you can do it with the 10,000 horse power engines nicely. I would like to ask one question in the case of the trial of the Daft motor whether the electricity was returned to the rails or not so as to cause any extra traction force which we expect under those circumstances.

MR. SLOAN: Yes, it was returned to the rails. It seems to me that the problem to be solved by electrical engineers is to retain the large amount of power that is wasted in transmission back and forth along the wire.

THE CHAIRMAN: I see that Mr. Pearson is here. Perhaps he has something to say.

MR. PEARSON: Mr. Smith and I have concluded that as far as engines and copper are concerned it is a standoff. If you don't buy engines you have got to buy copper, and if you don't buy copper you have got to buy engines. We await your decision.

MR. DELAND: Dr. Bell in his paper spoke of a series system. I would like to ask Mr. Dow his opinion of the use of a series system on a line similar to that Mr. Sloan has referred to.

MR. DOW: I am already on record as saying that the series system has advantages and Prof. Bell has gone on record in favor of the series system. There is no trouble whatever in running series system if you work it as a block system The block system is a perfectly similar affair, and even in its most perverse workings it may be rectified by the conductor getting off and hitting the switch with a club That is the extent of the trouble in case the car does happen to overrun. The blocks can be made as short as you please, so they be long enough to let one train in. There ought to be room enough in which to stop the train. If you do that it will be impossible to have collisions, because a car running out of its block not only stops itself, but stops any other car that may be on the same block, and until one is disconnected from the block the other cannot proceed. The blocks need be no longer than the length of the train plus a safe stopping distance.

MR. GRIER: Will Mr. Dow explain in regard to the regulation of the constant current motor when it leaves the end of the block? That is, in regard to the regulation of the dynamo in throwing the power on and off the dynamo. Is there any difficulty in the regulation?

MR. DOW: The dynamo is compound wound and the electromotive force and brushes are controlled automatically. The system permits the realization of another theoretical advantage, that is the electric brake. Hand brakes are never used. The series motors working at constant current are not affected as are the constant potential motors by having the current on when they are at rest. In fact they always have the current on them. A car will stand still with the current running through the motor without fall of potential beyond that due to the resistance of the copper wire of a fraction of an ohm. The fall of potential, when a car is moving, is exactly proportional to the work done.

MR. BUCKLEY: I would like to ask Mr. Sloan whether it required an average of 75 horse power for each of those 63 trains.

MR. SLOAN: Yes when the trains were going up heavy grades it required an average of about 75 horse power.

MR. BUCKLEY: Taking the 63 trains I presume the horse power developed for starting the heavy trains with one of your locomotives, can only be computed from the coal pile.

MR. SLOAN: Sometimes they get as high as 120 or 125, and sometimes 180. Where there are a large number of stations on our 2 per cent. grades, sometimes on wet days 180 horse power is developed.

MR. BUCKLEY: Then as I take it, if you require an average of 75 horse power per train all the time, you would have to have an aggregate for the 63 trains of 63 times 180 horse power. You must have that capacity for those trains. Now with an electric railway, equipped to do the same work, we should require a capacity in the motors of 63 times 75 horse power going all the time. The motor then would have to have a capacity of 180 horse power if it should be necessary to use that much. As we lose 50 per cent. in transmission, we would have to have engines developing twice 63 times 75 horse power in the station. Now the steam railway takes an average of six pounds of coal, which would be six times 75 horse power, per horse power hour, as against four times 75 horse power and reducing that to horse power hours, it would seem then that in the electric motor we fall in horse power hours 33⅓ per cent., and have 33⅓ per cent. maximum power at the station. Now the experiments so far gone into by Mr. Daft have shown that he does not get his traction force with his 128 horse power motor and has to have a larger one. Therefore the probabilities are that we would have to have fully the same capacity at the station as you have in your entire capacity of steam. But we would make a saving of 33⅓ per cent. in the coal pile, besides doing away with dust and dirt. Hence, if I were a director in the Manhattan company, which fortunately for them I am not, I would take exception to the doctor's figures as regards his saving of $400,000 per year at the coal pile and make it 33⅓ per cent. of $700,000. That would show to my mind very clearly that apart from this point the doctor's paper is very practicable and his figures are very nearly correct.

MR. SLOAN: Are you certain how much power you lose in transmission?

MR. BUCKLEY: It can be figured exactly. The question of loss, such as you speak of, in the return rail, by the spikes in the wood, soaked with resin, and eventually thoroughly saturated with moisture, is simply a question of insulation. That is one of the problems that has been solved, and it is simply the mechanical appliance of that insulation to prevent the loss

MR. SLOAN: It occurred to me that they were not properly insulated. I thought there was a great loss of power, lack of proper insulation.

You have got to have weight to get traction. You have got to have just as much on the drivers as we have now.

MR. LOUNSBURY: It seems to me that in this discussion we have only considered the economical results in the coal pile We do not consider that in running an electric road we would save at least a fireman on every train. That is, the difference between a fireman on every train, and the number of firemen required to fire a stationary engine at the station.

And another thing, we have to consider at what pressure to make the constant potential motors. The loss between the station and the motor could be materially reduced by improvement in our methods of insulation.

MR. GRIER: One question I would like to ask Mr. Dow is, whether in regulating those constant current motors the regulation is made at the motor by changing the position of the brushes.

MR. DOW: We move the brushes; you must remember that these motors so far have been constructed as open coil machines in exactly the same manner as the Brush machine, having the advantages of a large diameter of armature and slow shaft speed consequent thereon. They can be very easily regulated by the position of the brushes.

MR. GRIER: There is one more question, and that is, when the train enters the block, the load coming suddenly upon the dynamo, wouldn't it throw the belt from the dynamo?

MR. DOW: No, sir I can tell you what can be done with that dynamo, and the same thing can be done with constant potential dynamos as they are constructed to-day. Fifty to 75 per cent. of the load can be thrown off or on, or the entire capacity of the dynamo, and the regulation will be so quick that there is no perceptible jerk on the belt.

MR. GRIER: How would it be with a change of 100 per cent.?

MR. DOW: Throwing the whole load off is exactly equivalent to short-circuiting, and the shunt field discharges itself. The compound winding provides perfectly for that.

MR. TERRY: The question of investment will cut quite a figure; I don't know what comparisons would show if on the one hand we have a lot of small engines, and on the other, we have large engines, together with the necessary generators, etc. I don't know anything about the comparative figures; that has not been touched on very much, but it appears that this would be a very important item.

MR. GRIER: There is another question to be taken into consideration, and that is the possibility of using water power along the line of the railroad. In this way the total operating expenses might be reduced very materially. And there is still another fact which would be of comparatively small consequence perhaps, and that is the return of the power to the line. It has been shown by experiment, I think by Mr. Daft on the elevated road in New York, that the power returned to the line would just about balance the extra power required to start trains, so that the total power would be just about what the trains would take while running at their ordinary speed on a level.

PROF. BADT: I think it was stated that the manufacturers of electric light machinery guaranteed as high efficiency as 90 per cent. in dynamos and electric motors. In the large dynamos I think 92 per cent. is guaranteed. Let us assume that it is 90. We have then 90 per cent. of energy. We can make the line wire as small or as large as we want to; we can use a copper wire of large or small diameter; it is simply a question of money. We have a loss of, say 20 per cent., in the line, and we lose again 10 per cent. in the motor. I think it is pretty fair to assume that the efficiency will be about 50 per cent. It will probably be more. If we compare those figures I think it will be shown that we would save in the coal pile about one-third, as between stationary engines and locomotives. But there is nothing to prevent our making the loss in the wire 10 per cent. instead of 20 per cent. in a well laid out system of feeders and mains. I think Sir William Thomson's law will apply; whether it is advisable to spend more money for copper or whether it is cheaper to spend a little less money for copper, and a little more for fuel.

MR. DELAND: As I understand, the gentlemen who are going to put in the alley elevated line, have come here with the intention of making that road satisfactory in every respect; I also understand that they are willing to expend say $75,000 or $100,000 in experiments for the benefit of the city of Chicago. I do not know of anything that would benefit us more than to see electric motors running there in place of steam locomotives, which scatter smoke, cinders and ashes, and distribute oil along the line.

I understand that Mr. Ives, who made the drawings for the elevators in the Eiffel tower, is with us. He has also been connected with several of the elevated roads, and perhaps Mr. Ives will give us a few remarks on that subject.

MR. IVES: It was mentioned that I had been connected with the designs for the Eiffel tower elevators, and though this work was entirely separate from electricity, it formed a most interesting problem in a strictly mechanical line. As perhaps you all know, there was presented a different elevator problem from any which had ever arisen before, and if the term elevator is used, as we use it every day, I doubt whether it is correct in this case. The Eiffel tower elevator might very properly be called an inclined railway with an ever-varying gradient caused on account of the architectural effect desired by the designer of the tower. It was demanded that the central arch, which was thrown between the four converging legs should be kept clear, that the view might be unobstructed. Consequently a vertical rise was out of the question, and we were confined to the legs of the tower. We had to do the best we could to get up in the air in some manner. An entirely different arrangement from that used in an ordinary elevator was necessary and the work brought forth some very beautiful problems, but the only one which I will mention, is that of the counter balance. It is well known that it is desirable in elevators, as well as in electrical work, to do nothing more than you have to. Consequently if you can make the laws of nature, the law of gravity, do a portion of your work you are very glad to do so. Our car weighed 37,000 pounds, and a large portion of that was dead load, so that the question of counter-balance became one of great importance. But as the car ascended on this varying gradient, going through a difference of twenty-eight degrees in inclination, it is very readily seen that there was a constant variation in its resistance as it proceeded. In addition to this it was partly counter-balanced by the fact that the rope which were a very considerable item in such a high lift as that, continually goes over a sheave at the top, and that relieved the load to be lifted, but it did not relieve it to anything like the extent that the change in gradient, increased the resistance of the load. Now the question arose, whether it would not be possible to make a counter-balance which would carry this dead load on a reverse curve to that on which the car ascended; so that as the car presented more and more resistance in ascending, the counter-balance getting on to the steeper grade would present more and more effectiveness in counter-balancing. That was a subject which was very carefully considered, and the use of the counter-balance was found to be perfectly practicable, even though it was geared. Some idea may be gained of the tremendous powers we have to deal with when it is stated that for every foot movement of the piston in the cylinder there was twelve feet movement in the car, and that the pull on the two large piston rods which formed the connection between the piston and the multiplying sheave, which was a great car in itself, was 200,000 pounds.

There is one other point which was interesting in this matter, and that is, that Mr. Eiffel would not allow us to take hold and pull on the tower; consequently we had to construct inside of the legs of the tower independent iron work for this multiplying traveler to move on, so that the multiplied pull of twelve to one might go directly back to the foundation, and that all the pull the tower would have to sustain would be simply the exact weight of the live load, without any multiplication. Mr. Eiffel simply allowed us to hang in the axis of his tower, this additional iron work upon which the multiplying traveler moved up and down, and through which it transmitted its multiplied stress back to the foundation. It was, of course, a matter of very considerable consideration, and I should judge that never again will such a problem arise.

I think anybody that has had the experience that Mr. Eiffel has had, and that we had, who wants to go so very high up in the air in the future, will first build his elevator, and then he will build his tower around it.

Tempered Copper.

The history of the development of the modern method of tempering copper is interesting. Almer Thomas is the discoverer of the process now in use, and it is the result of his close study and observation. Having satisfied himself by experiment that the desired results could be accomplished, he so informed Eugene Merket, one day in 1885, when they were engaged in boring a Pennsylvania oil well. The confidence of Mr. Thomas made such an impression upon Mr. Merket that he soon after informed Alfred Short, a successful business man of Northeast Pennsylvania, of the possibility.

Mr. Short was very incredulous, for he was somewhat familiar with the great efforts which had been made to rediscover the art of tempering copper, which had been lost for hundreds of years.

About this time the Jarechi Manufacturing company of Erie, Pa., had a great deal of trouble with a journal bearing on the main shaft of their manufacturing establishment.

Mr. Thomas offered to remedy the difficulty with a tempered copper box. He claimed copper to be the only fibrous material in its natural state, and if it could be tempered sufficiently hard, without alloys, the result must necessarily be a better box than any crystalline material, causing little friction and operating with less oil.

The casting was finally made at Bradford, and was taken into the woods and tempered by Mr. Short in the presence of Mr. Merket.

When the box was placed in position on the shaft of the Jarechi Manufacturing company, it proved to be completely successful, and has continued in use to the present time.

This was followed by numerous other successful experi-

ments on locomotives, high-speed stationary engines and machinery of various kinds.

This result led to the organization of a corporation known as the Eureka Tempered Copper company of Northeast Pennsylvania, in which the Hon. Wm. E. Scott and other capitalists became largely interested, and of which Alfred Short became president.

The business was started with a small foundry and other limited facilities. The use for tempered copper rapidly increased, and recently the company has erected substantial brick buildings, with ample accommodations for the present demands of the trade.

It was soon discovered that tempered copper is admirably adapted for electrical purposes, and its use has already assumed large proportions.

Tempered copper is used in commutator bars, electric brushes, trolly wheels, trolly wires, street-car pinions and gears, and for similar purposes.

As tempered copper remains perfectly pure it does not suffer the loss of conductivity, as is the case when alloyed.

Samples of tempered copper submitted to Dr. F. A. Genth, 111 South Tenth street, Philadelphia, Pa., for analysis November 1, 1889, resulted as follows: Edge pieces, 99.961 pure copper; castings, 99.914 pure copper.

Recent tests made by G. W. G. Ferris & Co., civil engineers at Pittsburgh, Pa., show the breaking strain of a piece of tempered copper wire .0487 inches in diameter is 64 480 pounds, as against 34.840 pounds for a common copper wire .0511 inches in diameter. The extension of the tempered copper wire under the strain was 20 per cent. of its length, when an inch sample was used, and 3 per cent. when an eight-inch sample was taken. The extension of the common copper wire was 37 per cent. when an eight inch sample was taken, and 44 per cent when a two inch piece was tested

Recent tests made by Tiniees, Olsen & Co. of Philadelphia for the Franklin institute show the breaking strain of a piece of tempered copper having an area of .465 of a square inch to be 61.290 pounds to the square inch, and the elongation to be 4.3 per cent of the length of the wire tested, which was six inches long They also tested a piece of tempered copper one inch long with an end area of .4312 square inches by subjecting it to a pressure of 92.-700 pounds with a compression of .4 of an inch.

Disque Le Clanche Battery.

The illustration shows the new self-sealing disque Le Clanche battery, recently put upon the market by the Western Electric company of Chicago. The jar has a shoulder projecting inward; on its paraffined surface rests a paraffined ring of wood, through which the porous cup and zinc pass. The zinc has a rubber ring both

DISQUE LE CLANCHE BATTERY.

above and below the wooden ring, and the porous cup a paraffined shoulder, making it practically self-sealing. Three holes about half an inch in diameter in the bottom of the porous cup, which hangs entirely clear of the bottom, allow the solution to penetrate the ingredients as soon as immersed, and makes the battery quick acting. The battery will give 1½ volts e. m. f. within one minute after being connected up.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 22.—Judge Andrews of the Supreme Court has decided in favor of the Board of Electrical Control in the matter of awarding the subway contract. He has carefully gone over the whole ground and his decision seems to be based entirely upon the right of the Board of Electrical Control legally to award a contract to any company who can carry into effect the provisions and intent of the acts of the legislature. The judge says. "As the purpose of the act was to provide subways in which to place overhead wires, and as this purpose has not been effected, it seems to me that the contract has been ineffectual up to the present time. In order to provide accommodations the board desires to have between 50 and 60 miles of subways constructed as soon as possible, and it is of great importance to the public that that many miles should be completed during the year. The city is in partial darkness and the sooner subways are constructed the sooner will the public be provided with electric lights and power." The Standard Subway company has agreed to complete the work in one year and there is no other company which is in a position to do so, therefore it looks very much as if the Standard company would get the contract and the city will have electric light at the earliest possible moment.

When the Board of Electrical Control met to execute the contract for subways, a postponement was necessary, as the order on the decision of Judge Andrews vacating the injunction obtained by the Manhattan Electric Lighting company, which prevented the signing of the contract, had not been settled and entered. First Assistant Corporation Counsel Dean appeared and stated that on the application of Elihu Root and De Lancey Nicoll, representing the Manhattan company, Judge Andrews had made a provisional order staying all action until an appeal taken to the General Term of the Supreme court is decided. The General Term has agreed to meet and hear arguments on the appeal next Wednesday or Thursday. The signing of the contract and the building of additional subways is thus again delayed. An attempt was made on the part of the Harlem and East River Electric Light companies to appeal to the board in relation to a failure to provide them with accommodation for their wires in the subways, but Mayor Grant decided that the meeting was called for a special purpose and could not consider their complaints. A meeting for the consideration of general business will be held next Thursday at 11 o'clock A. M.

The Gas Commission met to-day and passed upon specifications for contracts for lighting the city with gas and electricity. The contracts will be for a year, beginning May 1.

The entries for the National Fast Telegraphing tournament were closed last week with 12 in class A, 24 in class B, 5 old timers, and 15 ladies. Thomas A. Edison has contributed $25 toward the prizes.

Another important decision was handed down last Tuesday by which Judge Coxe, indirectly, gives the Julien Electric Traction company the right to operate its system under the Brush patents, which apply to the mechanical application of the active material to the plates in a storage battery. Now that the Julien company has the use of the Brush patents, it is its intention to equip the Madison and Fourth avenue line, and other lines in the city with the system which gave such perfect satisfaction last season on the Madison avenue line. Fifteen cars will be added to the Madison avenue line immediately, and new cars will be built as fast as possible. The Julien company, it is claimed, obtained control of the Brush patents prior to this decision and has been awaiting the result with considerable interest.

The meeting of the American Institute of Electrical Engineers last night called together a very large assemblage of electricians and those interested in electricity. Dr. Louis Duncan, of the Johns Hopkins University, read the paper of the evening on "Some Tests on the Efficiency of Alternating Current Apparatus." These tests were made at the university by the students and instructors, and the paper was a most valuable one. The discussion which followed was entered into with a marked degree of interest

The scheme to tunnel the East river and unite the New York Central and Long Island railroad systems is taking shape. Resolutions of the chamber of commerce to gain permission from the city for constructing this tunnel were draughted and referred to the committee on harbor and shipping which will report at the next regular meeting in two weeks. According to the plans of the company organized to construct this huge tunnel, a double track railroad with a system of electric traction is to be used and the heaviest grade will be but 63 feet in a mile. The air will be kept fresh by a system of motor fans, and electric light will make the interior as light as day.

The Interior Conduit & Insulation company has been incorporated by Edward H. Johnston, Sigmund Bergmann, Edwin T. Greenfield and Philip H. Klein as trustees. The capital stock is $1,000,000.

At one of the recent hearings of the senate committee investigating the electrical conditions in this city the members of the committee showed that if they knew little about electrical matters they had managed to become acquainted with the character of some of the alleged experts and citizens who desired to appear before the commission, and that they did not intend to be imposed upon any more than they could help. As a result, a lively war of words was the order. Among the witnesses who have appeared were: George A. Hamilton, of the Western Electric company; George H. Benjamin, Prof. George W. Plympton, of Brooklyn; E. W. Martin, chemist of the Health Department; Wm. Maver, Jr., of the Consolidated Telegraph & Electrical Subway company, and Schuyler S. Wheeler, expert of the Board of Electrical Control. Paul D. Cravath read letters from Sir William Thomson, Prof. George Forbes, Dr. J. Hopkinson, W. H Preece and E. Fesquet of London. The witnesses as well as the letters all agreed that high tension continuous or alternating currents can with perfect safety be transmitted underground, and can also be carried with almost absolute safety overhead if properly insulated. They also agreed that underground was much the better place for electric light wires in large cities. The local experts, like all others who have appeared before the committee, favored a state commission and proper laws to regulate electrical currents. In Europe, it appears from the letters that alternating currents of 2,-500 volts are carried on the underground and overhead wires and no lives have been sacrificed to them. Prof Forbes in his letter said he had been in New York recently and noticed the condition of electric lighting after the raid on the wires, and he remarked this would all have been prevented "if the Board of Electrical Control had been composed of able and unbiased electrical engineers, or if the civic authorities had not lost their heads." Chemist Martin said ten thousand million cubic feet of gas were manufactured in this city last year, and nearly 10 per cent., or one thousand million feet, leaked into the ground, and a large part of this comes out again, to the injury of health.

Harold P. Brown has once more assumed the title of "electrical expert," and it is reported he is engaged as such by a street railroad company of a small city in the interior of the state. As the new law providing for electrical executions has been pronounced constitutional it would appear that his time would be pretty thoroughly occupied with the duties of his "official" position, as there are now five convicts awaiting their doom.

A meeting of the stockholders of the Postal Telegraph & Cable company was held Wednesday for the purpose of voting upon an increase in the capital stock of the company from $5,000,000 to $10,000,000, as recently recommended by the directors. About 70 per cent. of the present issue of $5,000,000 of stock was represented at the meeting, being for the most part that held by John W. Mackay and George W. Coe of the American Exchange Bank. It was all voted in favor of the increase. The additional capital is said to be needed to pay for increased facilities and betterments, and to take up local branches and extensions of the lines now held by Mr. Mosher.

W. H. T.

Duluth, Minn.

DULUTH, Minn., March 22.—President Samuel Hill and General Manager A. S. Chase, of the street railway company, met the members of the city council two days ago and discussed the electric railway right. Nothing was accomplished, as the aldermen and the street railway magnates held widely different views concerning the ordinance required. The committee on ordinances submitted the draft of an ordinance giving the right to the company to erect its poles and string its wires on the streets of the city, and which had a good many conditions. It closely follows the St. Paul ordinance in its general provisions, makes the maximum speed six miles an hour in the city proper and eight to ten in the suburbs, provides that the equipments shall be of the very latest and best kind; that the cars shal be properly lighted and heated; that the last car must not leave the terminals before 12 midnight, and that after 8 P. M., to that hour they must be run at intervals of not more than 30 minutes in each direction over the entire line, and from 5:30 A. M. to 8 P. M. at intervals of ten minutes, and that the tracks must be standard gauge. The company refused to agree to the ordinance, not recognizing the right of the council to make any, as the company already had its charter. Mr. Hill said: "I am glad to be here. My company wants to build up Duluth. We have all the money we could get and will invest it here. We all believe Duluth is to be a great city. I believe the aldermen are doing right, but they don't quite understand the situation. We have an old charter that we are willing to live up to. We don't believe it necessary to ask this permission, but simply do it as a courteous act." It is stated also that the company will not put in the electric line if the council insists on passing an ordinance making regulations, but continue the horse cars.

D.

Nashville, Tenn.

NASHVILLE, Tenn , March 22.—The electric light companies of this city have consolidated. The Nashville Light and Power company has transferred its franchise, wires, poles, plants, etc., to the Capital City Electric Light company. The consideration of the sale was $60,000 in stock and $50.000 in first mortgage bonds. The new company will at once provide $40,000 working capital, and proceed to increase the plant.

J. W. Russell and H. Holderman, representing the Thomson-Houston Electric Light company, propose to establish an electric light plant at Gallatin, Tenn. They propose to light the town with 60 lights, of 1200 candle power, for $1,000 a year.

A.

Kansas City, Mo.

KANSAS CITY, Mo., March 22.—The semi-annual meeting of special agents of insurance companies, doing business in Missouri, Kansas and Nebraska, closed at Excelsior Springs last week. In a paper read by Thomas F. Clohesy, electrical engineer of this city, on "The Relations Between Insurance and Electrical Companies," he briefly adverted to the fact that the introduction of electricity into the field of illumination and power had caused the insurance companies to demand higher premiums, and he deprecated such action as not well founded. By statistics he showed that from 15 to 25 per cent. of all the fires in the larger cities were occasioned by the use of coal oil, and maintained that electricity, so far from being hazardous in use was rather safer than any other illuminating agent if properly handled. Mr. Clohesy warmly advocated the adoption of simple rules of safety, based upon reasonable principles and experience, determining the degree of insulation for wires and their safe carrying capacity—rules that would permit none but thoroughly competent and trustworthy men to do the work of wiring, and that would require the examination of the wiring by inspectors, well informed as to approved methods. Proceeding on the lines of his suggestions, Mr. Clohesy said that the insurance companies could enforce with ease compliance with safety rules in electrical distribution, with the assurance of better risks, less trouble and greater profits than could be now had with high premiums and no inspection. The great hue and cry of the hour were "down with the dangerous wires." The municipal authorities and insurance people should see to it that the wires be made harmless if they were dangerous. The former should appoint an electrical inspector competent to judge of the safety of the external overhead wiring of all kinds, whether electric light, telegraph or telephone. He advocated the adoption of the methods of inspection employed under the authority of the New England Insurance exchange, and described it in detail. Then, at some length, he discussed the evils arising

from the present irregular methods, and declared that with inspection, thorough inspection, by competent men, the resulting conditions would be such as to justify the insurance companies in classifying electric lighting plants and buildings where electricity was employed as an illuminating agent, as being safe risks.

The University club will not be able to get into its club house this month as had been expected. It will be one of the finest club houses in the West. At its last meeting the house committee decided to light the new club house throughout with incandescent electric lights. The grounds and porte-cochere will be lighted by arc lights. The Edison company received the contract for all electric lighting, and wires are now being placed throughout the house.

The contract has been let for the construction of an electric railway from the terminus of the Grand Avenue Railway company's Fifteenth street line through to the Blue river. W. B. Knight, the engineer, will build the line, which is to cost $75,000. It is expected that the line will be completed by September 1. A number of teams and a strong force of men have been put to work on the road, and the force will be rapidly increased until it is sufficient to make the construction of the road one of the quickest pieces of street railroad work ever done in the city.

The ground was first broken at the intersection of Carrington avenue in the Blue Valley, where the Manchester branch will leave the main division on Fifteenth street. At the same point the Northeast division of the road will begin. Within ninety days over twelve miles more of splendid rapid transit road will be added to the 150 miles or more now in operation, and it will open up a section of the city unsurpassed for its facilities as a residence portion and several other sections recognized as the manufacturing districts of the city. Nothing will be spared, says the managers, to push the road to immediate completion, and make it a first-class electric road in every respect.

Ever since the Kansas City, Kas., council granted a franchise to the Consolidated Electric Light company to light the streets of the city with arc and incandescent lights for a period of twenty years, there has been a continual howl among certain citizens of the South Side. The people claim that by the action of the council that company was granted an exclusive right to light the city for a period of twenty years, and although the prices fixed at present are considered reasonable, yet it is thought that the time is not far distant when electric lights can be furnished for less.

The facts are that nearly two years ago this city, being one of the few important cities in the United States not lighted by electricity and having no electric light station, for the purpose of inducing the construction of such works, granted to this company a franchise for a term of twenty years, which contained a clause requiring the company to immediately construct a station and to establish and operate street lights whenever and wherever the city should direct, and binding the city to take of the company all electric street lights it should require during the term of the franchise. To comply with the conditions of this ordinance, the company expended about $130,000 in erecting its plant, and has in operation nearly 100 miles of wire, furnishing light cheaper than it can be obtained in any other city where the same conditions obtain. The prices fixed in the original ordinance for street lights to be furnished the city are, however, 33 per cent. less than the prices paid by Kansas City, Mo., and for private lights the company charges less than the prices paid in all important cities of the country. The fact is that the ordinance recently passed neither granted new privileges nor increased those previously granted the company, but rather curtailed them. The city for years has been paying for fourteen candle gasoline lamps, operated only twenty nights in the month, $22.50 per year each. In the amended ordinance this company proposes to introduce all the incandescent street lights of 25 candle power that the city may require, all night and every night in the year and all to be lighted at the same instant every night, for $19.92 per year, thereby furnishing a street lamp of nearly double the power of the gasoline lamps for 365 days instead of 245 days, and for $2.50 less per lamp. This company in order to keep pace with the rapid growth and development of the city and increasing demand for lights, is now arranging to double the capacity of its plant, and while already having the largest plant of its kind in the state, will make it second to none in the West.

The Missouri-Kansas Telephone company contemplates at an early date an extension to Kingman from Wichita, and also a line from Wellington to Harper and Anthony, which will put Wichita in talking reach with three more important towns in the Southwest.

For some time past the Rosedale council has been wrestling with an ordinance which, if passed, would grant to the Consolidated Electric Light company a very liberal franchise at that place. The people seem to think it much too liberal, so that when the ordinance was passed at a recent meeting popular indignation ran so high that the council reconsidered its vote Last week the aldermen were about to pass the ordinance again, when a delegation of 200 people checked legislation by breaking up the meeting and creating a riot on a small scale, even severely administering punishment to officers of the law who attempted to interfere.

The Kansas City Electrical society met last week. A paper on "The Telephone" was read by W. M. Pruitt, "The Quadruple," by H. M. Scholes. T F. Clohesy continued his paper on "The Possibilities of Electricity."

P.

It seems that the Paris telephone authorities have to protect their operators from the "impatience and anger" of subscribers. The penalty for an offence is the cancelling of the offender's subscription and repayment of the money. This would appear to be somewhat detrimental to the reputation of the French, who are generally regarded as the polite nation *par excellence*. The only interence to be drawn is that the ladies in the state employment over there are excessively exasperating.

THE ELECTRIC LIGHT.

The erection of an electric light plant at Dyersburg, Tenn., is projected.

The Culmer block, at Salt Lake City, Utah, will be lighted by 150 Thomson-Houston incandescent lights.

Goldsboro, N. C., will be illuminated by electric lights. The contract for street lamps was recently awarded the local company.

A Thomson-Houston 650 light alternating current dynamo has been added to the capacity of the Denver Electric Illuminating company, Denver, Colo.

Dr. W. C. Clark's new apartment building at Thirty-ninth street and Ellis avenue, Chicago, will be lighted from a Thomson-Houston 300 light motor type dynamo.

Canton, Mass. will have an electric light plant in the near future. The Westinghouse Electric company is engaged in installing alternating current apparatus for a 750 light plant.

The Chandiere Electric Light company of Ottawa has just completed the installation of a Westinghouse plant of 1,500 incandescent lights. Prior to this the company had in operation a United States plant running 2,500 lights, which makes a total of 4,000 incandescent lights now in use in Ottawa.

An English paper states that the employes of the Continental Edison company are shortly to receive uniforms, with indication of their grade, and that a whole army of electricians may be, therefore, expected shortly in Paris, each distinguished by the color of his cap and the amount of gold lace, indicating partisanship with the Edison, Popp, and Rothschild companies, as well as that of the municipal electric service. What a Chicago Edison man's feelings would be, if compelled to go uniformed, is left to the imagination of the reader!

Fraser & Chalmers of Chicago, have just placed orders for an incandescent electric light plant of a capacity of 35,000 8 candle power lights to be installed in Japan. The entire orders were captured by Chicago agents. The orders were distributed as follows: F. E. Degenhardt, for the Standard Underground Cable company, 17 tons line wire, which it was agreed should be shipped in five days; Westinghouse Electric company, dynamos, converters, lamps, etc.; Westinghouse, Church, Kerr & Co., engines, etc.; Central Electric company, electrical supplies.

William Hood, the Chicago representative of the New York Accumulator company, has closed a contract with Potter Palmer of the Palmer House, Chicago, by which 120 15 L. cells will be installed in the hotel. The accumulators will be used for illuminating the Turkish bathrooms in which gas is now used and for lighting the halls and laundry. The cells will supply with current about 200 lights. An accumulator installation was made about a year ago for lighting the private residence of Mr. Palmer and the cells have given such satisfaction that he determined to employ similar batteries at his hotel.

A correspondent of the WESTERN ELECTRICIAN writes in regard to the ventilation of subways: "It seems to me that a few well-distributed 1¼ inch ventilating pipes, carried from manhole to a building, and up the side of building to roof, would greatly reduce, if not altogether overcome these frequent explosions which some day may terminate in serious results. Gas, being twice as light as air, would find its way to the ventilating shaft, and ascend until it found an atmosphere of its own gravity; a fan or blower at one or more points in the line of conduit would, no doubt, facilitate operations."

The Missouri Electric Lighting & Power company has begun an injunction suit against the Postal Telegraph & Cable company, to restrain the latter company from interfering with its wires in the alley west of Twelfth street, between Market and Chestnut streets, St. Louis. The Missouri Electric Lighting company is doing the municipal lighting in the alleys, and alleges that the Postal, having constructed poles in the alley named in such a way as to prevent the construction of other poles, it, the plaintiff, proceeded to place its wires upon them under the direction of the Board of Public Improvements and in accordance with the city ordinances governing such matters, but that the Postal company has threatened to tear them down.

The Westinghouse alternating current arc light system, the special features of which are that it is used in connection with a single flat carbon lamp, is now being introduced in the city of Pittsburg Last Sunday night about sixty of the lamps were operated in the east end of the city, and a number of prominent men and the representatives of the local papers were invited to witness the innovation in street lighting. In speaking about the matter the next day one of the Pittsburg papers said: "The new system of arc lighting of the Westinghouse Electric company was successfully tested in the east end last night. In this system but one carbon is required to each lamp, which lasts 42 hours. The light from these lamps is 20 per cent. brighter than that from the arc lamps, and much steadier. The machines can be manufactured to generate electricity for 150 arc lights, thus affording a great deal of economy of space. The system is also claimed to be perfectly safe because it is operated with the converter, which reduces the voltage of the current to such an extent as to render any accidental shock perfectly harmless."

THE ELECTRIC MOTOR.

Capt. Eugene Griffin, head of the railway department of the Thomson-Houston Electric company, will address the Electric club, of Harvard University, on "Electrical Transmission of Power," Monday, March 24, at 7:45 P. M. The lecture will be given in the lecture room of the Jefferson Physical Laboratory, and the public is cordially invited.

The old fashioned way of mining coal with the pick and shovel is rapidly becoming a thing of the past in the Monongahela coal region. The mining machine is constantly making headway and it will not be very long until it will have entirely superseded the old method. With the introduction of these machines, however, electricity is also receiving a great boom, because demonstrations have proved beyond a doubt that it is the most suitable motive power for the machines. In the Monongahela valley the Hercules mining machine has gained extraordinary popularity with the coal operators. In connection with the Hercules mining machine the Tesla alternating current motor is operated. A few months ago the first Hercules machine and Tesla motor were introduced in the first pool of the Monongahela coal field. Since then, however, the orders for this machine have greatly increased. The last mine in which electric power is utilized for the production of coal is the Armstrong mine. The contract for an equipment was concluded only a few days ago, and the installation of the machinery will take place within a very short time.

The displacement of steam engines by the electric motor for general work has become so common an occurrence that it is now looked upon as a matter of course, and it is only the application of electric power to work which could not be done by any other means, that elicits more than ordinary attention. A case in point is the movement and control of hydraulic gates at a distance of several miles from the point of operation. The Elektron Manufacturing company, of Brooklyn, have recently built two Perret motors for this purpose, one to be used at Marion, O., at a distance of three miles, and the other to be used at Decatur, Ala., at a distance of a mile or more from the operator. The dynamo used in each case is a small constant current machine. By changing the direction of the current at the dynamos the motors, which are series wound, are run in either direction at will. It is of course well known that with an ordinary series motor, a change in the direction of the current on the line does not change the direction of rotation of the armature, because the current in both field and armature is reversed at the same time. In the case referred to the reversal is effected by an ingenious automatic device, invented by Frank A. Perret, the electrician of the Elektron Manufacturing company. It is attached to the motor and keeps the polarity of the fields unchanged regardless of change in direction of the current on the line, while the current in the armature, and consequently its direction of rotation is reversed with each change in the main current. The water gates are thus controlled and placed in any desired position at the will of the operator, miles away, by simply turning a switch lever.

A description was given some time ago of a large installation for the electric transmission of power, which was being manufactured by the Sprague Electric Railway & Motor company for Forbes Reef Gold Mining company, of the Transvaal, South Africa. This plant will transmit power from a waterfall, where are situated a number of Pelton wheels, to the mine, more than three miles away. The wires connecting the power house at the water wheels with the electric motors at the mine, will be carried upon poles right across country in a direct line. The amount of power transmitted will be 140-horse power. The Forbes Reef company is now so thoroughly satisfied that electricity is the most convenient and economical agent for transmitting power long distances, and applying it at its point of use, that the managers of that company have ordered additional apparatus, including dynamos and motors, with wires for the transmission of 75 more horse power. This will make a total of 215 horse power to be transmitted from the water power, which will be used on the mine premises. The efficiency of the whole electric system will be about 70 per cent.; that is, out of every ten units of power delivered from the turbine to the dynamo, seven units will be delivered from the motor pulleys for work, and only three lost in the transmission in both machines Part of the apparatus has already been shipped to the Transvaal, and rest will follow soon. The construction and installation of this plant will be under the direction and supervision of Wm. Rydler, of the Sprague Electric Railway & Motor company When this is finished it will be one of the largest, if not the largest and most extensive electric mining transmission plant in the world. It will probably not be long before many of the water powers in America, which now run to waste in many mining localities, will be utilized with advantage.

THE TELEGRAPH.

The Western Union Telegraph company has invited the house committee on postoffices and post roads to visit the company's headquarters in New York. This is the committee that is considering Postmaster-General Wanamaker's scheme for a postal telegraph.

Edward Rosewater of Omaha, appeared before the congressional committee at Washington last week to advocate the cause of the government telegraph. He desired to secure a lower rate for messages and stated that a ten or fifteen cent rate would be remunerative.

The Pan-American conference received the report of the committee on communication on the Pacific ocean March 21st. Government aid is recommended to be given to the company which shall connect the principal ports of the nations bordering on the Pacific by means of sub-marine telegraphic cables. It is also recommended that the nations which are now members of the universal postal union adopt existing conventions as to postal drafts and the exchange of postal money orders, or that they enter into special conventions having the same ends in view. The conference has adopted the report of the committee on communication on the Gulf of Mexico and the Caribbean sea, already published.

A Boston dispatch under date of March 21, says: "Jas. W. Converse, who was president of the American Rapid Telegraph company as long as it had an active existence, and who now has charge of its affairs, in speaking of the transfer of United Lines property said to-day: 'The trans-

ter of the lines between Cleveland and Chicago was sufficiently secured to us by the order of United States court of March 6, 1888, but our attorneys thought it better to obtain deeds of the property with the judicial order for a consideration. The Western Union pays us a monthly rental for the lines. It has offered to buy the property, but upon terms that we could not accept. For all that, however, the outlook for a sale is favorable."

The Pan-American conference is considering the report of the committee appointed to consider the best means of extending and improving the facilities for commercial, postal and telegraph communication between the several countries bordering on the Gulf of Mexico and the Caribbean Sea. The committee says that the telegraphic service meets all requirements, and is to be considered satisfactory. Cable communication is by two lines from the United States to the republics of the south. Present rates make it practically impossible to do business over these lines, and the committee recommend that steps be taken to secure a moderate scale of charges. This failing, then charters, it says, should be granted to independent cable companies, the maximum tolls to be fixed in the charters.

Miscellaneous Notes.

The first action in St. Louis growing out of damages from electric wires is now in progress. Miss Tillie Smith has sued the St. Louis Illuminating company for $10,000 damages, alleged to have been sustained by coming in contact with an electric wire of the company's system.

Electricity has stepped in mercifully to alleviate the miseries of the early riser on dark winter mornings. An arrangement has been devised by which a connection is made between the room clock and the stove. The clock indicator is set over night to any required hour, and when the hour hand reaches that time in the morning an electric connection is established with the stove, which is then lighted by an electric spark. The sleeper in the meantime is not disturbed. As the temperature of the room rises, however, it is indicated by a small thermostat, and when it has reached a point of summerlike comfort an alarm is sounded. The sleeper, of course, is awakened, but the act of jumping out of bed has now no terrors for him, and the morning ablutions are performed without a shudder.

Ex-Congressman John M. Glover of St. Louis, spends much of his time now in New York and Washington, but according to advices from those cities he has ceased to take any active part in politics, being wholly absorbed in business. A contemporary says: Mr. Glover has recently met with a rare stroke of luck. He found in St. Louis a few years ago a Swedish inventor who had made some wonderful discoveries in the way of electrical and steam appliances—among them a new microphone and a rotary steam engine. He investigated them, had faith in them and secured a fine string of patents. He is confident that he has a million dollars in sight for himself, while the poor Swedish inventor, who seemed unable to do anything without a partner with capital, has been placed beyond even the dream of avarice.

Personal Mention.

Mr. Goodrich of the Omaha electric railway, was in Chicago last week.

A. H. Lewis, of the C. & C. motor office, Chicago, returned from New York this week.

A. N. Bauer, electrician of the Pullman Palace Car company, Chicago, returned from an eastern trip last week.

Frederick Bathurst of London, England, reached New York recently. He intends to remain some time in America, partly on business and partly to inspect electric light installation.

The following named gentlemen were among those who visited the Chicago Electric club last week: Jean A. Wetmore, New York; James Godfrey, New York; P. C. Ackerman, New York; H. P. Lucas, New York.

Frank Rae of the Detroit Electrical works, was a visitor at the Chicago Electric club last week. Mr. Rae has just returned from Fort Worth, Texas, where he has been superintending the re-equipment of the Fisher-Rae electric road at that place.

L. B. Stilwell, electrician of the Westinghouse Electric company, read a paper on the subject, "The Distribution of Light and Power by Electricity," before the Engineers' Society of Western Pennsylvania, at Pittsburg, Pa., on the evening of March 18.

E. C. Noe, assistant superintendent of construction with the Leonard & Izard company, Chicago, has accepted the position of superintendent of construction with the United Edison Manufacturing company at Toronto, Canada. W. M. Hand, of the Leonard & Izard company, has taken Mr. Noe's position in that corporation.

Business Mention.

A new form of suspension pulley for arc lamps in street service has been invented by Elmer P. Morris and is now being placed on the market by the Novelty Electrical Supply company of Cincinnati, O. It is thoroughly insulated and protected from sleet and snow.

Jean A. Wetmore of the Norwich Insulated Wire company was in Chicago last week. Mr. Wetmore is now enthusiastic over the paper insulation which covers the wires sold by the company which he represents. Its insulation resistance, he says, is high and its static capacity low.

The Aluminum Battery company have established a branch office at 94 Church street, New Haven, Conn. They are receiving many orders in that vicinity and are installing a plant at Wallingford, Conn., which will operate two five horse power motors in a machine shop.

The Bishop Gutta Percha company is adding to the capacity of its factory on East Twenty-fifth street by installing a new 1,000 horse power boiler of the Bigelow make. This enlarges the boiler capacity to 1,700 horse power. In a letter to the company the Manhattan Electric Light company reports that the cable in One Hundred and Twenty-fifth street, now in use fifteen months, carrying a direct current of 2,500 volts shows no deterioration of insulation whatever, and that the cable in Union Square carrying an alternating current of 1,000 volts three miles for over a year, shows the same splendid results. The Bishop company is now manufacturing a very superior line wire to be used in the Brooklyn service.

Among the recent orders of English, Morse & Co., Kansas City are the following installations: Manitou, Colo., Electric Light company; Antlers Hotel, Colorado Springs, Colo.; G. D. Shultz & Co., Independence, Mo.; the National Smelting & Refining company, the Exchange building, Long Bros., and the Kansas City Packing & Chase Refrigerator company of Kansas City. This company has sent several hoisting engines to Pueblo, Denver, and special machinery and supplies to numerous other points recently. It will furnish a complete Rock Crusher outfit to the Fort Scott railroad, consisting of a No. 4 Gates Crusher and a 30 horse power Atlas engine and locomotive boiler. Another interesting outfit soon to be shipped is a steam equipment for the Wire Dredge Manufacturing company at Galveston, Tex. It includes a 45 horse power boiler and a 6-inch centrifugal pump.

The Baxter Motor company is preparing to do a large business. With well equipped shops at Baltimore, covering five acres, containing the best and latest improved tools and machinery south of New York, handled by the most skilled mechanics, the Baxter Motor company will maintain its reputation for efficiency, reliability and workmanship of its machines. Arrangements for furnishing duplicate parts of motors are perfect; every part of the motor is worked and completed to a standard gauge, thereby insuring perfect workmanship. Every motor is thoroughly tested, both electrically and mechanically, and a minute report is made of the machine before it leaves the shop. All motors are guaranteed. This company is now determined to push forward and avail itself of the latest improvements made under the Baxter patents, notably in electric elevator motors. The 150 horse power generator will also be placed on the market at an early date.

Electrical Patents.

Issued March 18, 1890.

423,421. Apparatus for Producing Steam, Heat, and Light by Electricity. Theophilus D. Farrall, Michigan City, Ind.

The invention is applicable to locomotives and stationary and marine engines, and also to buildings, and is useful for other purposes where heat, steam or light is required.

Of the twenty-six claims the last is given:

"For generating heat, steam, and light by electricity, the combination of an electric-heating cartridge, and a steam-generator adapted for conjoint operation, electric lighting apparatus electrically connected, and operative connecting mechanism."

423,449. Electric-Wire Moulding. John A. Seely, Brooklyn, N. Y.

The invention consists of a flexible moulding, made in any length desired, and preferably of waterproof material. The wires are securely placed in the strip during its fabrication. The moulding is therefore in one piece, there being no necessity for a capping. The invention further embraces a novel joint block or section.

Claim one reads as follows:

"An article of manufacture consisting of a flexible and non-elastic moulding in which are embedded one or more electric wires."

423,462. Electric Switch. George H. Whittingham, Baltimore, Md.

423,468. Electrical Connection with Car Tracks. George G. Campbell, Milwaukee, Wis.

The second claim is given:

"The combination of a metal plate or rail adapted for a portion of a car-track, in combination with a wire and a sleeve or plug thereabout secured in the plate permanently."

423,487. Fire or Police Telegraph. George C. McCullough, Richmond, Ind.

The invention consists of a repeater for use in fire and police telegraph systems, whereby a break in any circuit connected therewith will be instantly known in the stations of all the circuits, and said repeater also insures the correct transmission of the signals from one circuit to all the other stations, notwithstanding breaks in the same.

423,488. Electric Switch. Thomas McEvoy, Waterbury, Conn.

423,494. Annunciator. Charles E. Scribner, Chicago, Ill.

423,495. Crossing for Electric Conductors. Henry A. Seymour, Washington, D. C.

Claim one reads:

"In an electric railroad system, the combination, with two or more conductors, of insulated plates, each plate having a conductor secured thereto, said plates being supported at an angle to each other and in different horizontal planes."

423,527. Electrical Conductor. George E. Miller, Lynn, Mass.

423,549. Electro-Therapeutic Appliance. Charles E. Bruoning, Stockton, Kan.

423,552. Electric Railway System. Ludwig Gutmann, Fort Wayne, Ind.

423,553. Alternating Current Electric Regulator. Ludwig Gutmann, Fort Wayne, Ind.

Claim six follows:

"The combination, in an electric converter, of a subdivided coil, and pole-changers connected in circuit with subdivisions of said coil."

423,575. Individual Telephone Call. Joseph Sack, Dusseldorf, Germany.

423,594. Galvanic Battery. Martin M. Clark, Chicago, Ill.

423,600. Ampere Meter. Gustav A. Frei, Boston, Mass.

423,616. Galvanic Apparatus for Dental Surgery. Charles Wm. Manker, Nebraska City, Neb., and George F. Manker, Bedford, Iowa.

423,617. Electrical Device for Use in Dental Operations. Charles W. Manker, Nebraska City, Neb., and George F. Manker, Bedford, Iowa.

423,632. Electric Wire Supporter. William F. Rothenberg, Denver, Col.

423,637. Carbon-Rod for Arc Lamps. Charles E. Scribner, Chicago, Ill.

The invention coosists in a wire securely connected with the clamp proper, and extending up into the inside of the tube which forms the rod, the wire being bent so as to form sure sliding contact with the interior of the rod.

423,638. Cut-Out for Electric Arc Lamps. Charles E. Scribner, Chicago, Ill.

The invention consists in a differentially wound lifting magnet, with circuits and switching apparatus connected therewith, and so arranged that when the descent of the rod is arrested, or, in short, when for any cause the arc becomes abnormally long, it will go out and the circuit will be maintained through the different coils of the lifting magnet, so as to neutralize the same.

423,654. Coin-Operated Display Apparatus. Edward H. Amet, Chicago, Ill.

423,680. Water-Level Indicator and Alarm. Ira A. Fuller, Pepin, Wis.

423,697. Bell. Louis M. Pinolet, New York, N. Y.

423,707. Electric Bell. Arthur F. Stanley, New York, N. Y.

423,708. Static Electrical Machine. Hugo Tirmann, Cleveland, Ohio.

423,732. Method of Welding Metals by Electricity. Charles L. Coffin, Detroit, Mich.

423,733. Method of and Apparatus for Electric Welding. Charles L. Coffin, Detroit, Mich.

The process consists in connectiog the articles to be welded with the poles of a geoerator of electricity in open circuit, closing the circuit by causing an electric spark to pass the break in the circuit, and bringing the articles together to form the weld when sufficiently heated.

423,734. Method of Welding Metals by Electricity. Charles L. Coffin, Detroit, Mich.

The process consists in separately heating the edge of each article to be welded by passing a heating current through said article in proximity to the edge to be welded, and forming the weld by pressiog the heated edges together.

423,735. Method of Welding Metals by Electricity. Charles L. Coffin, Detroit, Mich.

The method consists in inclosing the articles to be welded between conductors, electrically heating the inclosing conductors, and forming the weld by pressing together the articles to be welded when brought to a welding heat.

423,736. Method of Welding Metals Electrically. Charles L. Coffin, Detroit, Mich.

The method consists in bringing the edges to be welded to a welding heat by the action of an electric current and pressing them together by the attractive force of a magnet.

423,753. Electric Burglar and Fire Alarm. William Gee, New York, N. Y.

423,788. Lightning Arrester. George S. Maxwell, Louisville, Ky.

423,807. Arc Lamp. Henri Pieper, Fils, Liege, Belgium.

The invention relates to electric lamps in which the light is produced by means of an electric circuit, a carbon rod, and two or more electrodes being in contact with one end surface of the said rod, so that when the electrodes are excited the current will pass transversely through the carbon—i. e. vertically to its length.

The second claim follows:

"In an electric lamp, the combination of a carbon rod, an electric circuit, and two or more electrodes in contact with one end of the said rod, one or more of the said electrodes being tubular and inclined upward from their points of contact with the carbon."

423,873. Elevating and Lowering Electric Lights. Robert Kinney and John P. Hebendahl, Weatherly, Pa.

423,874. Means for Supplying Electricity to Tram-Cars. Alexander L. Lineff, Chiswick, County of Middlesex, England.

423,886. Electric Railway Gate. Morton Toulmin, Baltimore, Md.

423,891. Switch for Electric Apparatus. Samuel L. Barriett, New Orleans, La.

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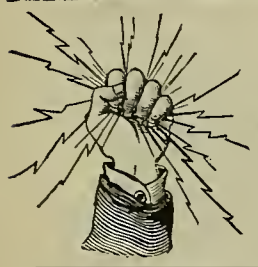

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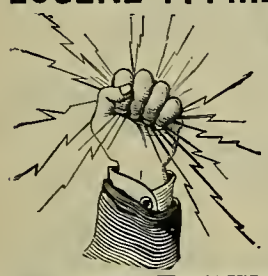

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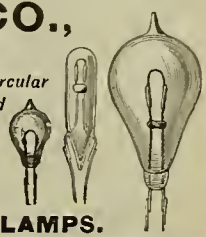

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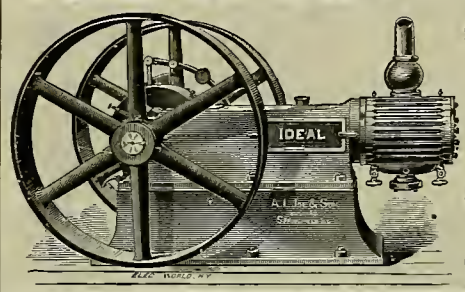

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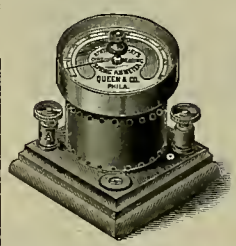

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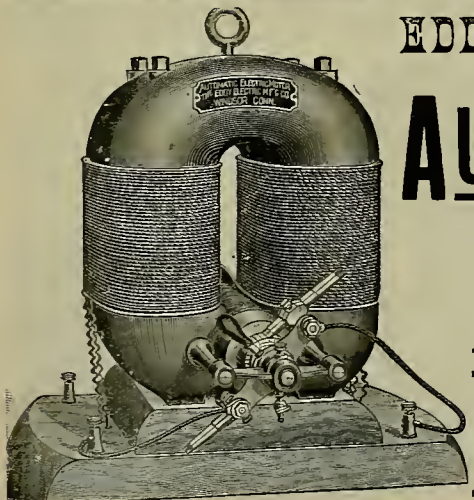

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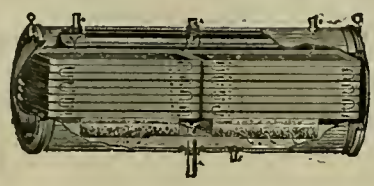

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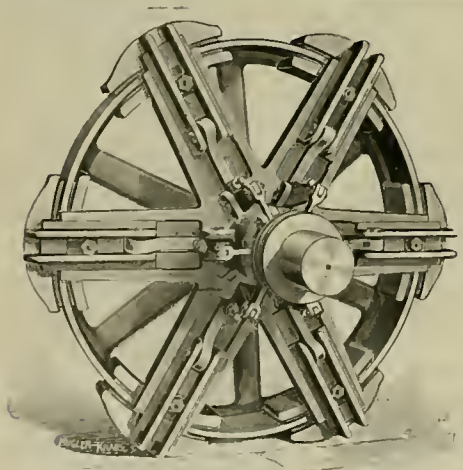

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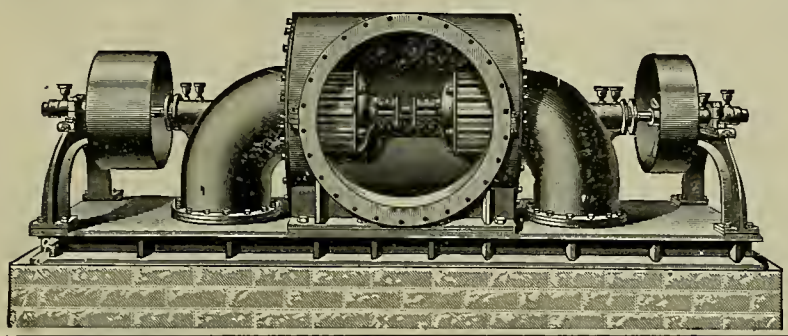

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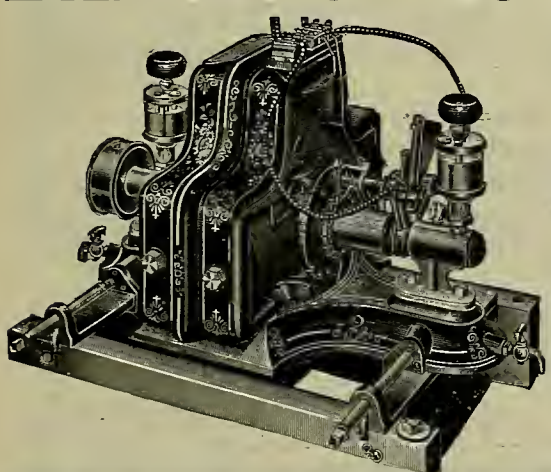

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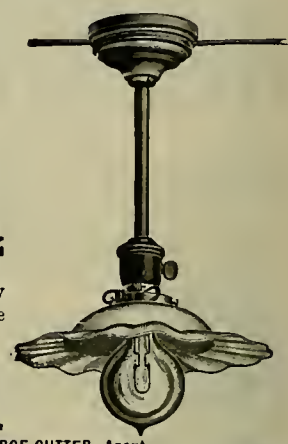

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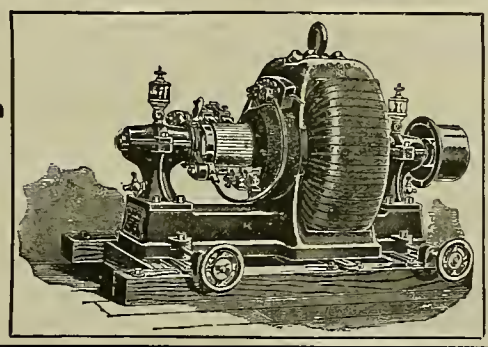

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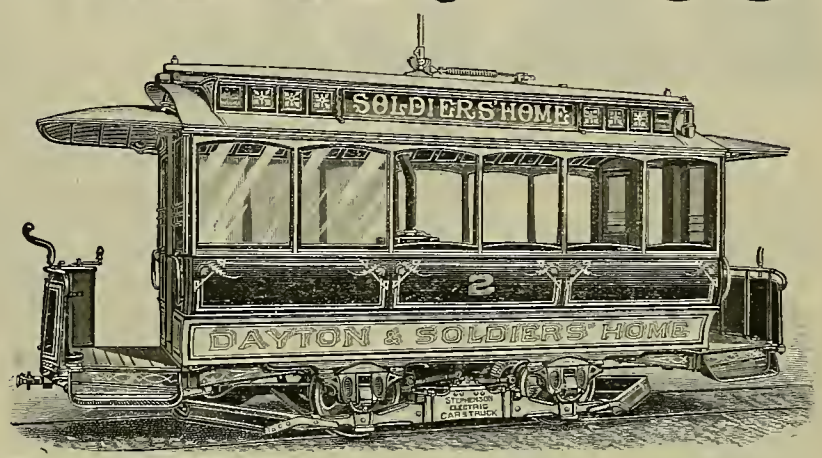

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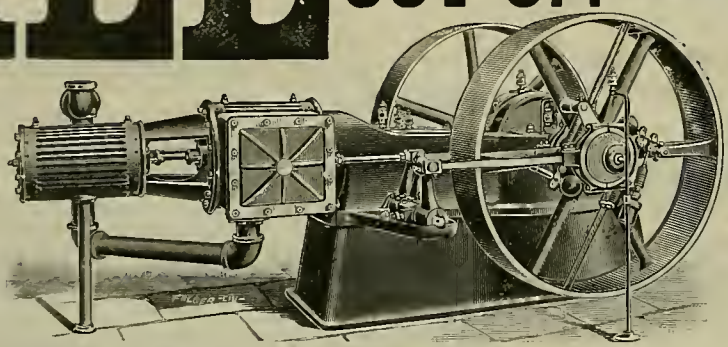

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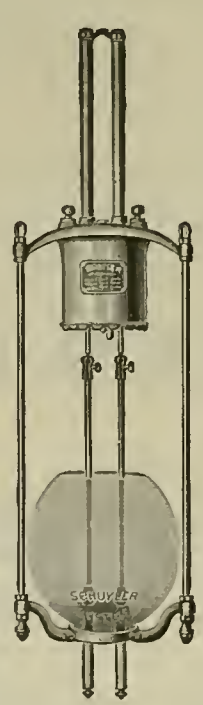

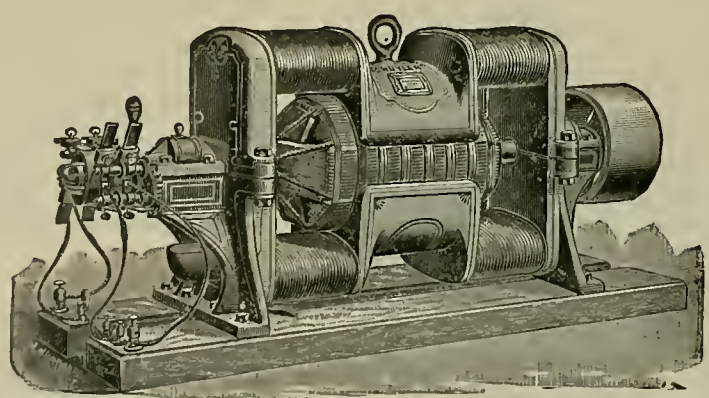

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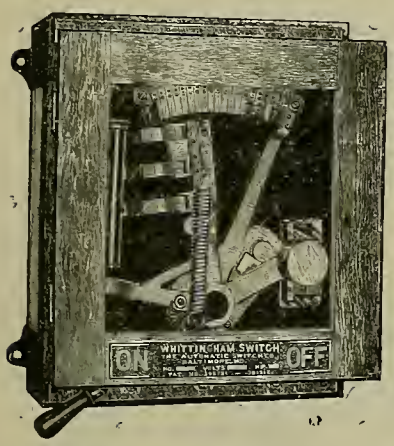

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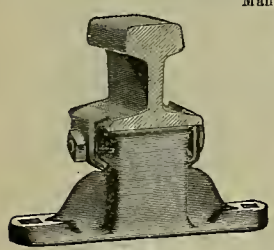

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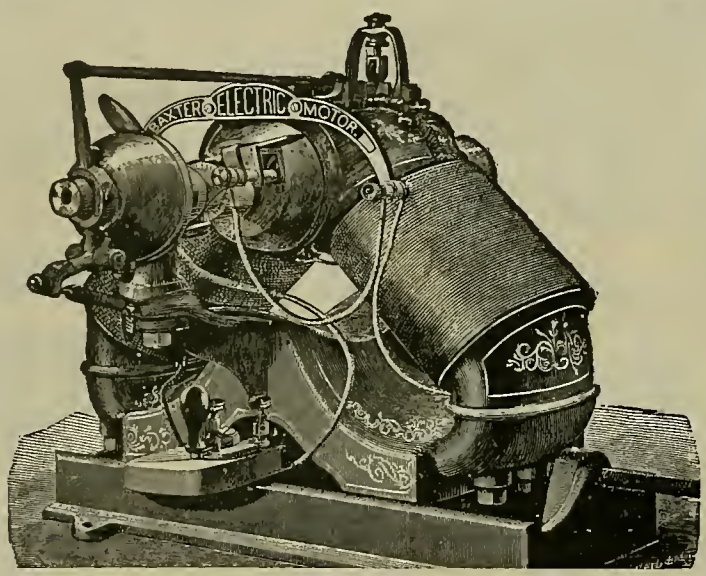

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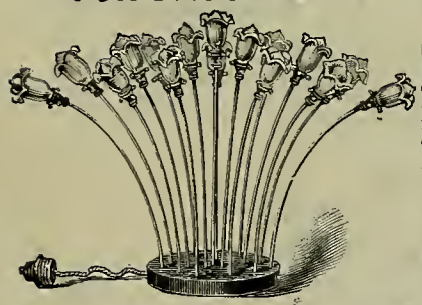

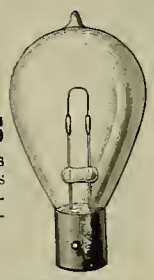

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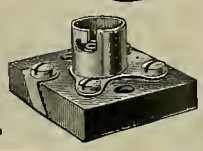

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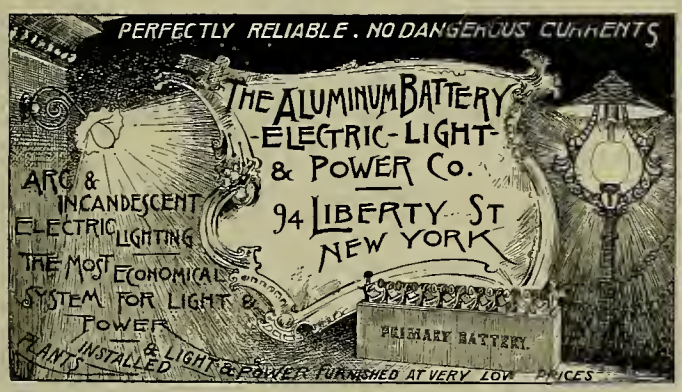

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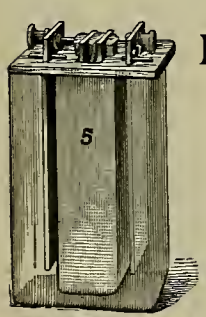

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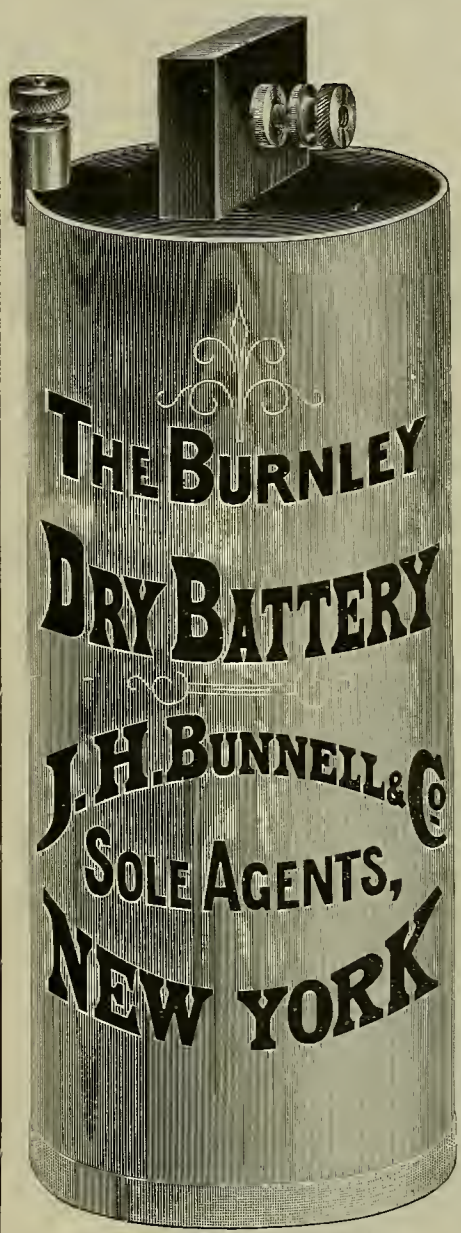

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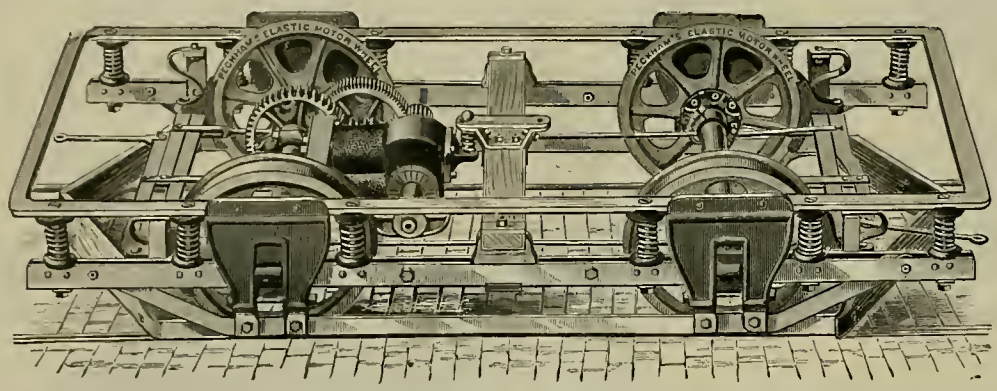

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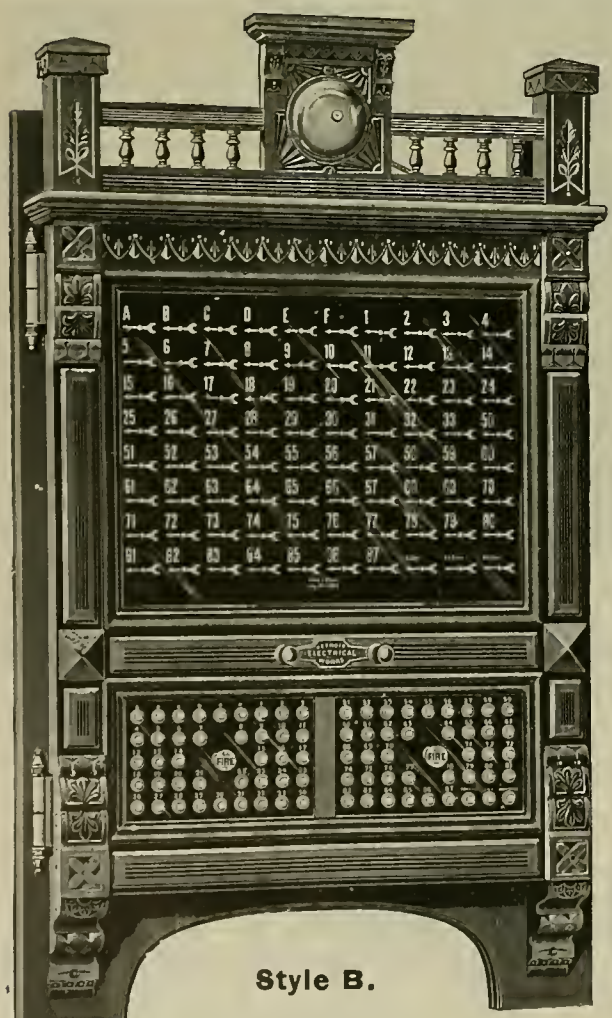

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The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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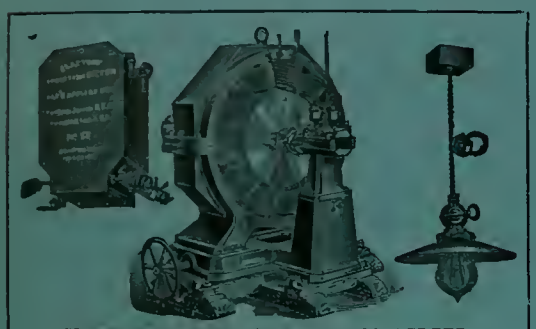

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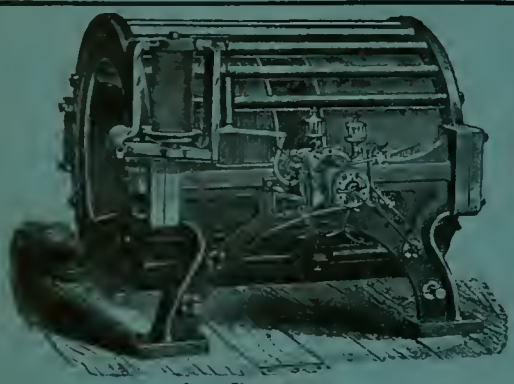

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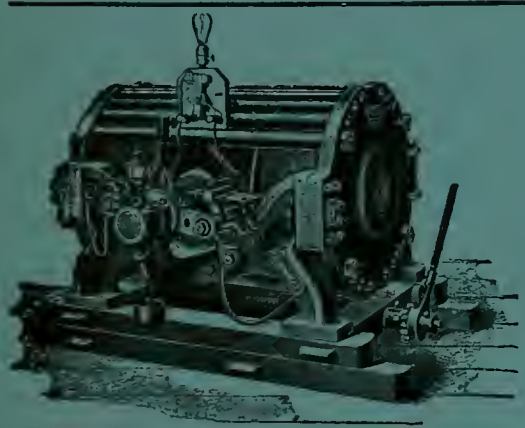

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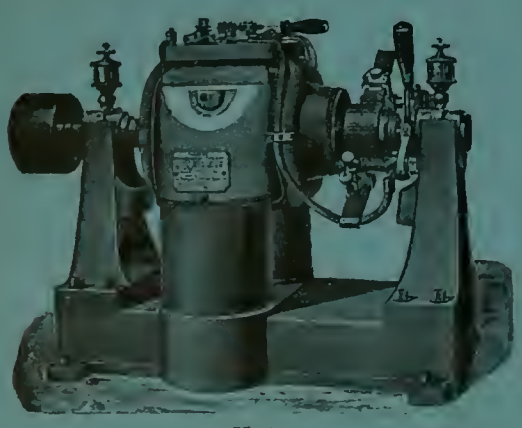

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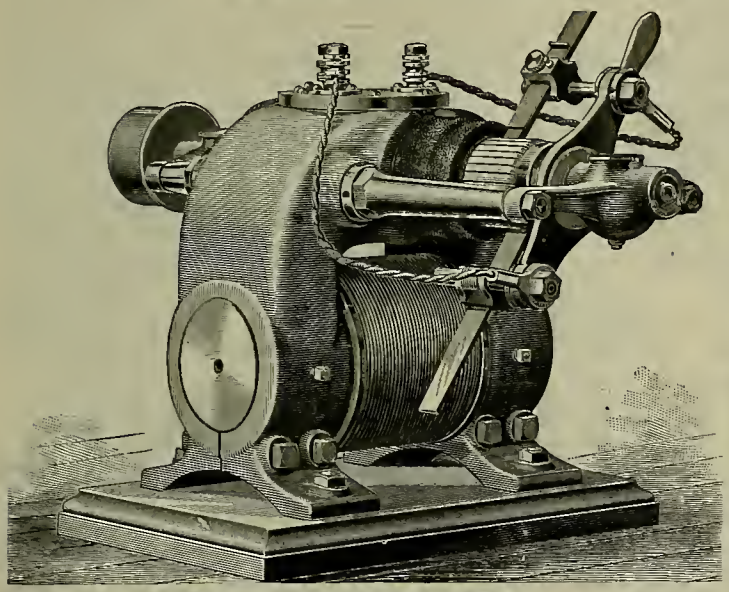

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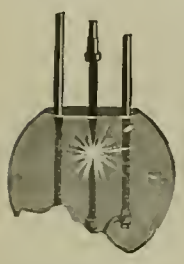

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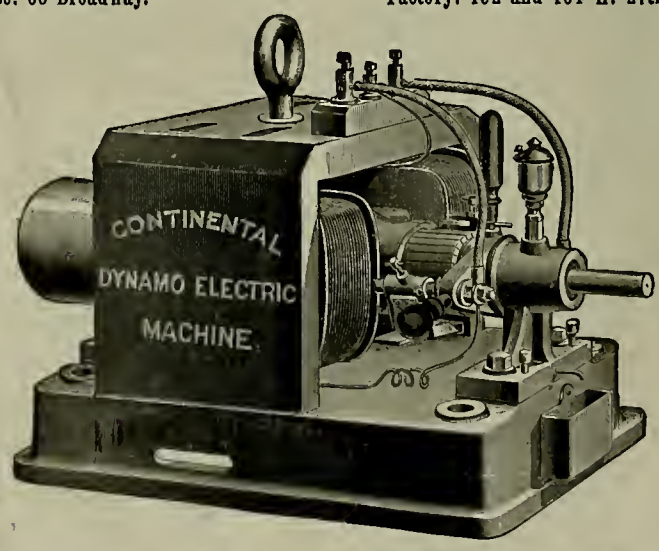

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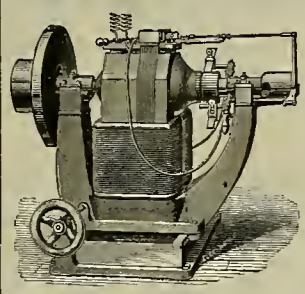

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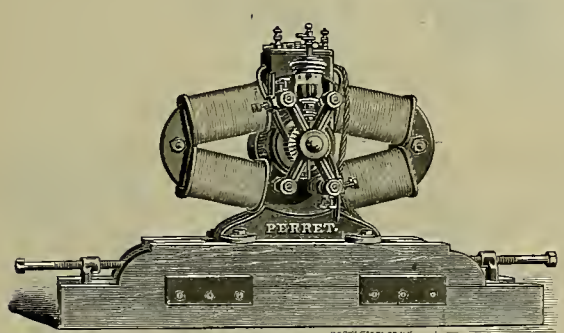

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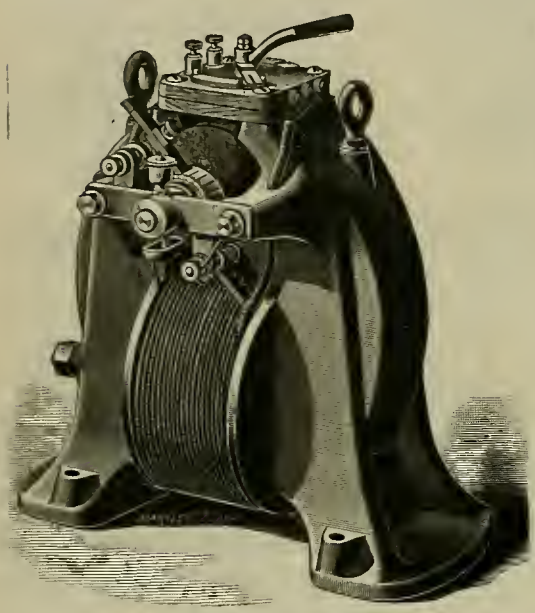

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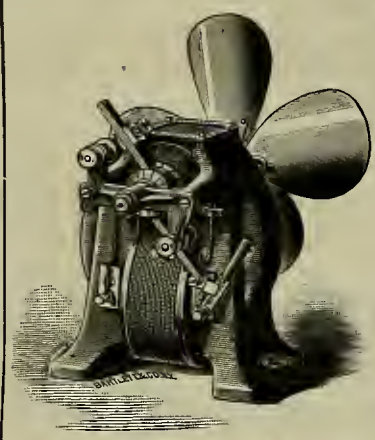
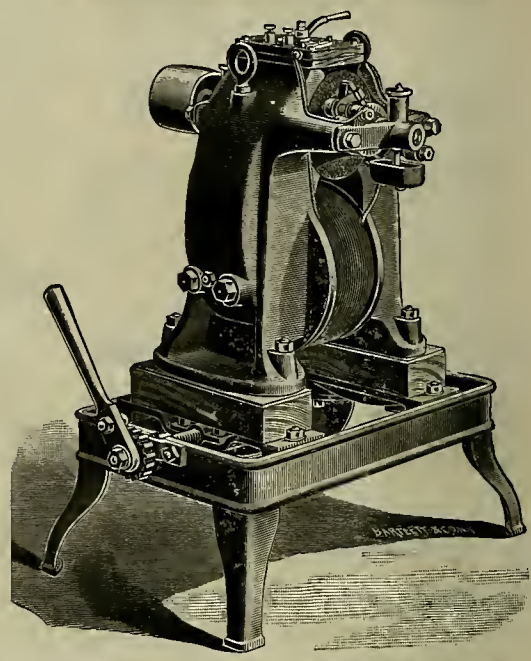


FAN MOTOR.



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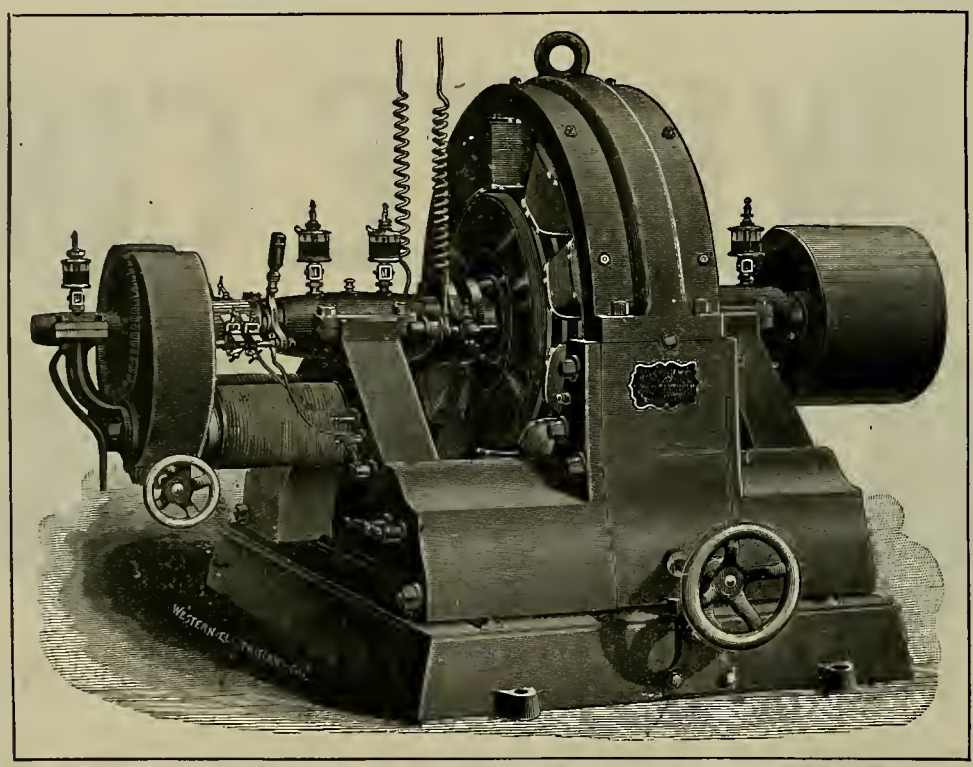

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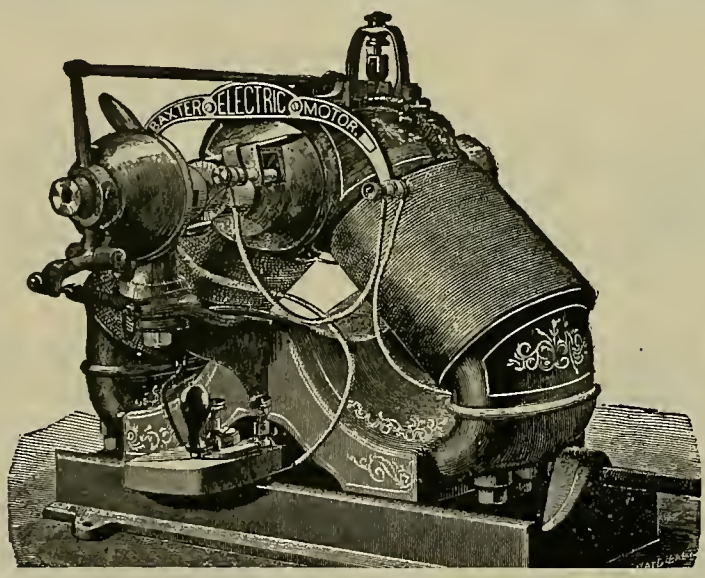

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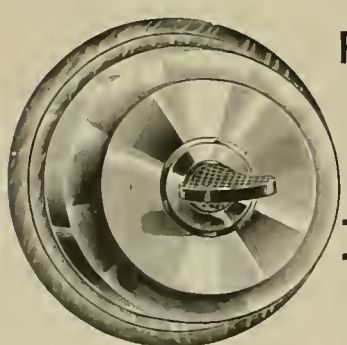

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Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, APRIL 5, 1890. No. 14.

Combined Engine and Dynamo.

The accompanying cut illustrates a neat and compact combination of engine and dynamo, which was built for the Springfield, Ill., Electric Light & Power company.

The dynamo is a 225-light Sperry incandescent machine. The engine was made by A. L. Ide & Son of Springfield, Ill., and is of the Ideal type. It is of 25 horse power, and is coupled directly to the armature shaft—in fact, the armature is built on an extension of the engine shaft. The dynamo is wound for 110 volts at 500 revolutions, which is the speed of the engine.

Damage to Electric Wires in Chicago

The storm which swept over the country last week did considerable damage to electric wires wherever it visited. In many places communication with the outside world was necessarily suspended for a time, as the telegraph and telephone wires were down. The railroads too, felt the effects of the storm on the telegraph service. The damage sustained by the Western Union and Postal companies was enormous.

In comparison with other cities Chicago had little reason to complain of the effects of the storm. Of course, the trouble which affected the service generally throughout the country was felt by the telegraph companies, as it became necessary to handle business sometimes in a roundabout way, but by persistent labor it was found possible to avoid serious delays. As the wires in the city, excepting in the suburban districts, are underground, less trouble was experienced in the telephone and telegraph service than elsewhere. Wherever the wires were in the air, however, there was considerable trouble, and in many places poles were blown over and wires broken.

The amount of the damage caused by the storm is not known, but will be quite extensive, even in Chicago.

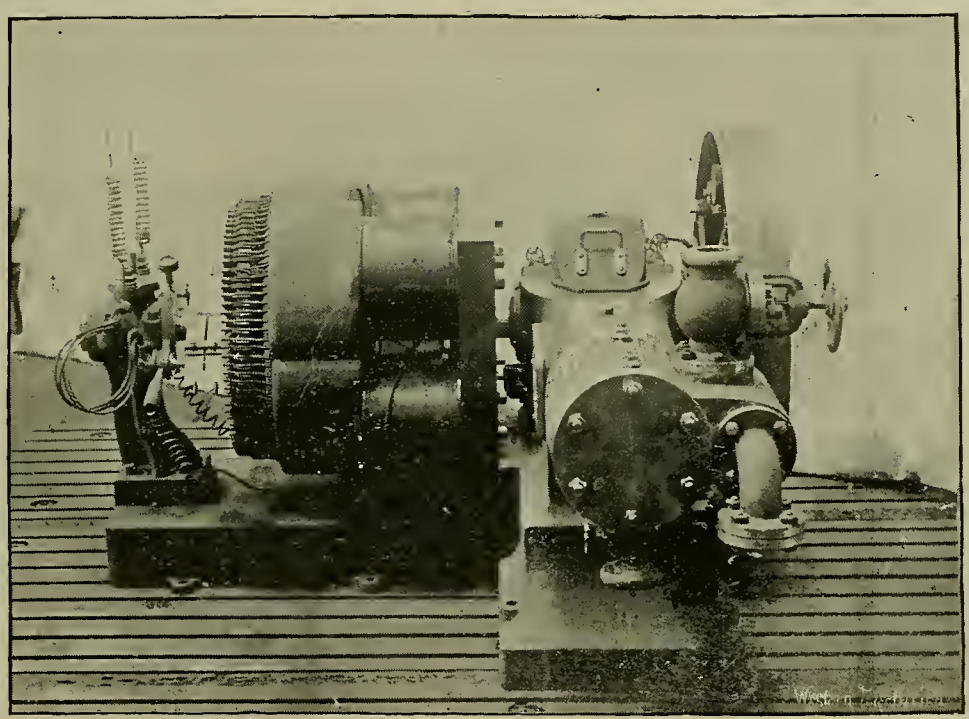
Electric Roads for St. Louis.

One hundred miles of street railroads will be equipped with electrical apparatus and be in operation within six months in St. Louis, Mo. That city has recently granted numerous franchises to new companies to build new roads to be operated by electricity, and has also granted permission to old companies to change their systems into electric roads. The people of St. Louis are to be congratulated on the strides they have made in the establishment of this system of rapid transit.

There are now seven systems using electric power or preparing for its immediate introduction. These are the Lindell, Union Depot, Southern, Missouri, Mound City, Benton & Bellefontaine and Broadway. Franchises have been granted to all of these companies for lines whose aggregate length will be 100 miles.

Many of these lines are now well under way, and will be in readiness at an early day. The Southern Railway company is finishing its line work and will probably begin operating under the new system April 15th. This company has already thirteen miles of road equipped. There are twice that number of miles of track in the Union Depot lines which will be formally transferred to an electric system May 1st. The Mound City line which now has seven miles of track will replace its bob-tail cars with handsome electric motor trains about July 4th. The Benton and Bellefontaine line will be constructed during the summer, and will probably be ready about the middle of the season. This system covers an excellent portion of the city. It will equip eight miles with electrical apparatus at once. The progress that has been made in equipping the Lindell system is well known.

There has been a decided change in the public mind relating to electric street railways. Two years ago the people of St. Louis would not give the subject any thought whatever. They absolutely refused to consider the subject seriously, but now they have the greatest confidence in the system. The action of conservative Boston in adopting the electric system did more than anything else to convince the St. Louis public that there was little to fear. If Boston could stand it, certainly St. Louis could—that was the argument, and it proved efficient. In every case the overhead system has been adopted here.



COMBINED ENGINE AND DYNAMO.

The Olathe, Kan., Electric Light & Power company has been granted a franchise to build an electric street car line and establish electric light and power service. The capital stock of $75,000 has been subscribed, and work will begin at once.

Future of the Electric Motor.

Joseph Wetzler concludes his article in *Scribner's* on the "Electric Railway of To-day" by making the following prediction: "With the advantages of the electric railway so clearly pointed out, and so unquestionably demonstrated in actual practice, it would not be unsafe to hazard the opinion that, in ten years, at the farthest, there will not be a horse railway in operation, at least in our own country. The horse will then be once more returned to his legitimate field of labor, and the street car passenger will be transported at an increased speed, and with all the comforts of easy riding, in cars propelled and lighted by electricity; while it is by no means improbable that, with further work on the line indicated, the passenger may step aboard a train in New York at ten in the morning, and eat a five-o'clock dinner in Chicago on the same day. Enough has indeed been accomplished to show that electricity is destined to be one of the most powerful factors entering into our social conditions, and that the ease of distribution and convenience of power afforded by it must bring forth changes in the social order which are even now hardly realized."

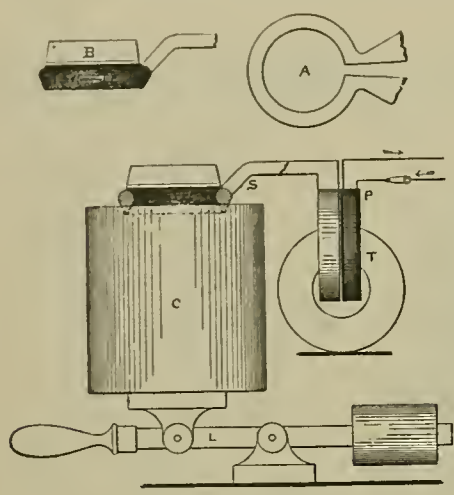
Minneapolis Electric Road Contracts.

The Minneapolis Street Railway company is completing its arrangements to transfer its entire system into an electric road. It has just awarded several large contracts for material and will begin the work of line construction at an early day. The system will be an innovation in electric roads. The feeders will be buried in conduits and a single line of poles with a cross piece on top will be erected in the center between the tracks. The trolley wires will be suspended from this arm over the tracks. On Saturday, March 29, the contract for the wire was awarded to the John A. Roebling's Sons & Co., through George E. Bailey, manager of the Chicago branch of this concern. The contract calls for 100 miles of lead encased cable for underground feeders and 100 miles of weatherproof insulation line wire for overhead work. There will also be required several car loads of copper fixtures to be supplied by the same company. This single item of expense for wire, etc., will amount to over $250,000. The shipments of wire and cable will begin in May, and be continued until the completion of the road. Mr. Bailey estimates that there will be 70 cars of cable, wire and fixtures in this order aggregating 14,000,000 lbs. This is one of the largest contracts for wire ever made in this country, certainly the largest ever made for electric railway purposes in the world. The necessary poles will be supplied

by the Walworth Manufacturing company of Boston, and the ties, 85,000 in number, by W. F. Brown & Co., Minneapolis.

Electric Soldering.

The development of electric welding, illustrating as it does the tremendous heating power of the electric current, has naturally led to the invention of devices by which heat may be applied in a somewhat similar manner in other processes in the arts. In the accompanying cuts are represented a method and apparatus, recently patented by Elihu Thomson of Lynn, Mass., by which the heating power of the current



ELECTRIC SOLDERING IRON.

is utilized in the process of soldering the covers of tin cans. The essential apparatus where the alternating current is to be used, is extremely simple. It consists merely of a peculiar form of converter *T*, with its primary *P* connected as shown, and the secondary *S* made of very low resistance and shaped with a loop or ring shaped end extending horizontally as indicated. This extension is so made that its lower edge or surface will coincide with the line of solder about the edge of the lid of the can. This construction will be understood by reference to figures *A* and *B* in the cut.

In order to insulate the ring from the can, mica is interposed. The mica is protected from injury by being itself faced with a thin ring of metal. To operate the device the current is switched on until the ring is brought to the proper temperature. The tin can *C*, carried by the weighted lever *L*, is then pressed up against the heated conductor. While the process described relates to the soldering of cans, Prof. Thomson has applied the method in other processes where materials are united by the employment of heat to fuse or melt the uniting material.

United States Patents not Affected by the Lapse of Foreign Patents.

An important patent decision was handed down in the United States Supreme court March 24, in which the points at issue in the celebrated Bate refrigerating case are revived. In the Bate case the court decided that a United States patent granted after the issue of a Canadian patent for five years for the same invention did not expire at the end of the five years, provided the Canadian patent had been kept alive, that is, extended for further terms of five years each to fifteen years under the Canadian law. At the time this case was under discussion it was asserted that a United States patent would expire with the lapse of a previous foreign patent for the same invention. The WESTERN ELECTRICIAN in an editorial March 23, 1889, contended that this view was erroneous, but Circuit Judge Wallace of New York and District Judge Thayer of St. Louis, subsequently, however, held differently. Now, however, the United States Supreme court steps in and reverses the decision of Judge Wallace, and describes the point at issue, taking the same view as that expressed in this paper a year ago. It is now an established rule that a United States patent is not affected in any way by the lapse of a foreign patent for the same invention by reason of failure to pay the tax required by the foreign government. The United States patent is good to the full end of the original term of the foreign patent, though the foreign patent may become void or lapse for any reason whatsoever prior to the end of the original term of the foreign patent. This is the judgment of Justice Blatchford of the Supreme court, who wrote the opinion on both the Bate case and that of Pohl et al against the Anchor Brewing company, which has just been decided. In the latter case the Supreme court says:

"There is nothing in the statute which admits of the view that the duration of the United States patent is to be limited by anything but the duration of the legal term of the foreign patent in force at the time of the issuing of the United States patent, or that it is to be limited by any lapsing or forfeiture of any portion of the term of such foreign patent, by means of the operation of a condition subsequent according to the foreign statute. In saying that 'every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent,' the statute manifestly assumes that the patent previously granted in a foreign country is one granted for a definite term; and its meaning is, that the United States patent shall be so limited as to expire at the same time with such term of the foreign patent. Such term was held in the Bate Refrigerating company vs. Hammond to be fifteen years, and not five years.

"This view is made conclusive by the requirement of section 4887, that if there be more than one prior foreign patent, the United States patent shall be so limited as to expire at the same time with that one of such foreign patents having the shortest term. This means the foreign patent which, at the time the United States patent is granted, has then the shortest term to run, irrespective of the fact that the foreign patent may afterward lapse or become forfeited by the non-observance of a condition subsequent prescribed by the foreign statute.

"In the view that section 4887 is to be read as if it said that the United States patent is to be so limited as to expire at the same time with the expiration of the term of the foreign patent, or if there be more than one, at the same time with the expiration of the term of the one having the shortest term, the interpretation we have given to it is in harmony with the interpretation of the words 'expiration of term' in analogous cases. (Oakley vs. Schoonmaker 15 Wendell, 226; Beach vs. Nixon 9 N. Y., 35; Farnum vs. Platt 8 Pick, 338.) In those cases it was held that the words 'expiration of term' do not mean expiration of term through a forfeiture by breach of a condition, but mean expiration by lapse of time. The decree of the Circuit court is reversed, and the case is remanded to that court with a direction to overrule with costs, the plea of the defendant, to assign it to answer the bill, and to take such further proceedings as shall not be inconsistent with the opinion of this court."

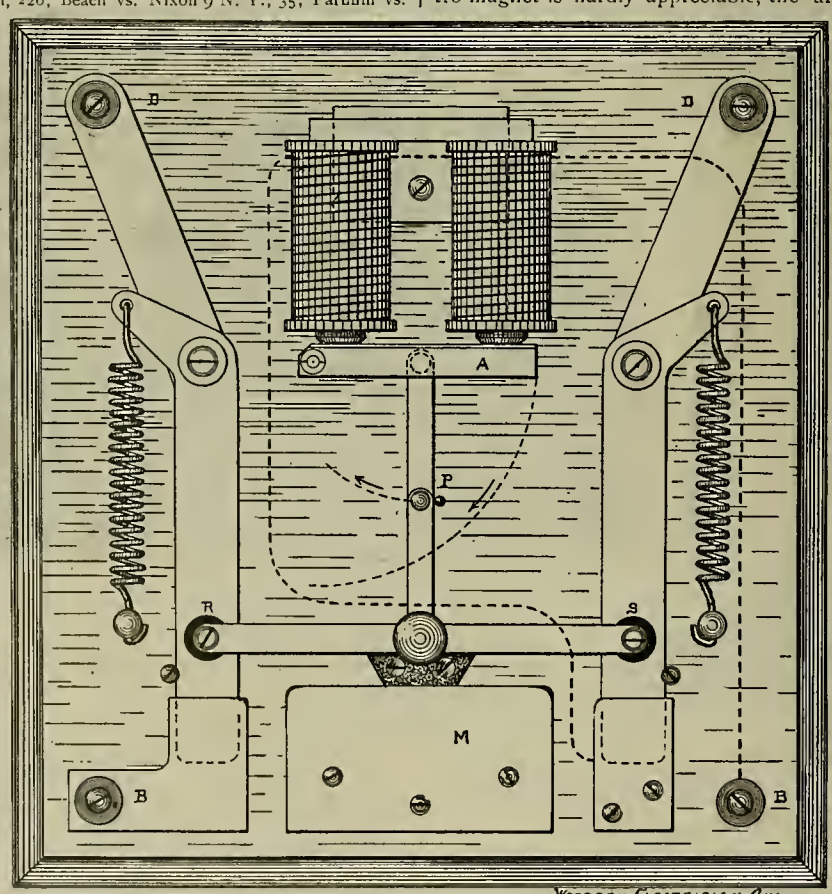
Six miles of electric street railroad will be constructed and equipped at Albany, Ore., during the present season.

Chicago City Electric Light Plant.

After considerable delay the city council of Chicago passed the appropriation bill for the ensuing year last Monday evening. The tax levy contains an item of $510,000 for street lamps and electric lights, and to this sum will be added $200,000, which is derived "from other sources." How much of this will be used for additional construction for the electric light plant cannot be determined until the estimates for street lamps are overhauled. The reports of the several departments were so high that the estimates, as presented to the council, exceeded the sum that could be raised by taxation by $169,000. It was therefore found necessary to cut down the appropriation for several departments, and one of these was the electric department.

Storage Battery Cut-out.

The accompanying cut illustrates a new form of storage battery cut-out, designed by Foree Bain of Chicago. In certain forms of cut-outs employed to prevent a reversal of current in the process of charging accumulators by means of a constant current dynamo, an armature, controlled by an electro-magnet connected in the charging wire, is used to break the circuit. In this type of cut-out the armature is, as a rule, directly connected to movable contact pieces. This arrangement has been found to be inefficient, owing to the fact that any considerable fluctuation in the charging current is liable to cause the device to operate prematurely. With a view of overcoming this trouble, Mr. Bain has constructed a switch of the form shown in the cut. In this device the armature *A* is entirely disconnected from the conducting bars of the switch—that is to say, the electro-magnet has to support no additional weight. A glance at the cut will show just how the device operates. When the current falls to a point where its effect on the electro-magnet is hardly appreciable, the armature



STORAGE BATTERY CUT-OUT.

A drops and hits the stud *P*. This upsets the knuckle connection and permits the two springs to throw the arms *S* and *R* into the contact clip *M*. As binding posts *D* and *D* connect with the dynamo, and *B* and *B* connect with the battery, it will be readily seen that the battery will now be cut out and left on open circuit, while the dynamo circuit remains unbroken.

In Italy there are at the present time 13 central stations run by water power and supplying alternating currents.

Alternating Current Motor.

Those of the readers of the WESTERN ELECTRICIAN who have watched the progress made by alternating current workers toward the development of a motor for that system, are aware that N. Tesla of New York, invented what

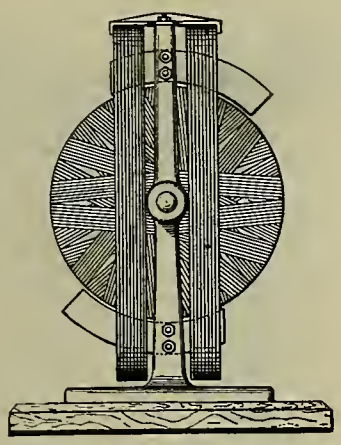


FIG. 1.

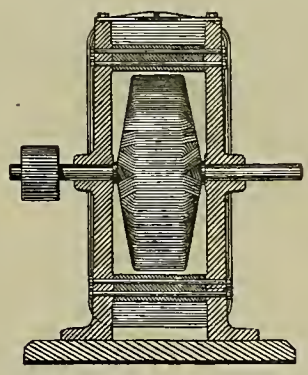


FIG. 2.

ALTERNATING CURRENT MOTOR.

might be termed a "magnetic lag" motor. In this motor the armature, which is of the closed coil type, is mounted within the magnetizing influence of a certain number of field magnets of different magnetic susceptibility—that is to say, poles of unequaled length, mass or composition. When an alternating current is passed through the coils of such a motor, the field magnets or poles do not appear to manifest their attractive effect upon the armature simultaneously, the magnetic attraction of some appearing to lag behind that of others, with the result of producing a torque and rotation of the motor. Mr. Tesla recently invented another form of motor, which for similar reasons may be called a "magnetic-lag" motor. In operation, however, this type differs from the one described, in that the attractive effects or phases of the poles, while lagging behind the phases of current which produce them, are manifested simultaneously and not successively.

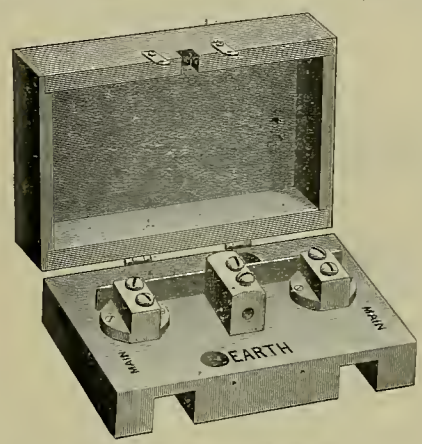
In this last-named type the principle embodied is that both the armature and field receive their magnetism from a single energizing coil or a plurality of coils acting as one.

The accompanying cuts illustrate this motor. Fig. 1 is a side view, and Fig. 2 is a sectional view at a right angle to Fig. 1. The machine may be described as follows: Bolted to the upright supporting-frame are two laminated iron pole pieces. The armature body, as will be seen, is of the circular disk type, built up of plates of iron and mounted in the frame between the pole pieces. This armature is wound with a number of closed coils. The main energizing coils shown supported on the frame, are so disposed as to include within their magnetizing influence, both the pole-pieces and the armature, the pole-pieces projecting out beyond the coils on opposite sides, as indicated.

Now, if an alternating current be passed through the main coils, the armature will be caused to rotate. The rotation Mr. Tesla explains as follows: An impulse of current in the main energizing coils establishes two polarities in the motor. The protruding end of one pole-piece, for instance, will be of one sign, and the corresponding end of the other pole-piece will be of the opposite sign. The armature also exhibits two poles at right angles to the main coils —like poles to those in the pole-pieces being on the same side of the coils. While the current is flowing there is no appreciable tendency to rotation developed; but after each current impulse ceases or begins to fall, the magnetism in the armature and in the ends of the pole-pieces lags or continues to manifest itself. This action produces a rotation of the armature by the repellant force between the more closely approximating points of maximum magnetic effect. This effect is continued by the reversal of current, the polarities of field and armature being simply reversed. One or both of the elements—the armature or field—may be wound with closed induced coils to intensify this effect. Although in the cuts there is shown but one of the fields, each element of the motor really constitutes a field, wound with the closed coils, the currents being induced mainly in those convolutions or coils which are parallel to the main coils. Where this type of motor is to be driven by current from generators yielding a very high number of alternations, the inventor employs a modification of the form described.

The Thomson Protective Device.

While sensational articles in the daily press have done much to exaggerate the danger of the electric current, especially of the alternating system, and while these stories happily cannot



THOMSON PROTECTIVE DEVICE.

be substantiated by facts, it is useless to maintain that high potential currents can be handled with impunity. On the other hand, however, it is unquestionably a fact that they can be handled without danger to life or property if ordinary common sense precautions are taken.

In the use of electrical apparatus of any description whatever, it is the best, and therefore the only proper practice, to use in construction, such care and devices as will eliminate entirely all liability to accident or injury.

The Thomson-Houston Electric company in all installations of alternating current apparatus for incandescent lighting employs the Thomson protective device, shown in the accompanying illustration. It is a simple but effective appliance, for removing the possibility of accident which might arise from contact with the secondary circuit.

Three conditions must simultaneously arise before this possibility can be said to exist: First, there must be a ground on the primary wires; second, there must be a contact between the primary and secondary coil in the transformer; and third, the person must be in contact with the secondary and the earth at the same time.

The existence of the first condition is of common occurrence, but the presence of a ground can be easily detected, and means can be at once taken to remove it. The second condition is met with seldom, and is only liable to occur if transformers have been injured or subjected to rough usage in shipment. The third condition rarely obtains. The remoteness of liability to accident is quite apparent when it is remembered that these conditions must simultaneously exist; and even then the extent of the injury depends upon the relative position of the contacts with reference to the two primaries.

As the coincidence of the above conditions is, of course, not beyond the range of possibility, the device herewith described has been designed to prevent any injury resulting from a contact with the secondary wires, when those requirements are fulfilled. It consists of three brass terminals, to the central one of which is rigidly attached a flat brass spring pressing against the two outside terminals, but normally held out of contact with them by slips of Thomson paper film. That paper film is very carefully prepared, so that it readily withstands the pressure of the spring, but is instantly ruptured when the first and second conditions mentioned above, are satisfied. To the central terminal is attached, by means of a binding screw, a wire connected with the earth. To the inside terminals the secondaries are led directly from the transformer. When the difference of potential between the earth, with which the brass spring is in contact, and either one of the outside terminals, to which the secondaries are attached, should rise beyond the normal pressure, the paper film is at once punctured. This results in short-circuiting the secondary, which causes the fuse to blow, thereby cutting out the entire installation.

Electric Valve-Controller.

The little device illustrated in the accompanying cut was devised by Prof. Elihu Thomson for operating a valve by electricity. The operation of the appliance is simple. In Fig. 1 *B B'* are two glass receptacles which are filled with a vaporizable liquid, such as alcohol or ether, and then securely sealed. They are connected by glass tubes, as shown in the cut. The device is pivoted at *T*, at which the receptacles are in equilibrium. In the chamber *B* is arranged a resistance *H*, connected with wires, which are sealed hermetically in the bulb. When current is allowed to flow through the resistance, heat will be generated and vapor will be formed, which, as it cannot escape, will press downward upon the surface of the liquid and force it

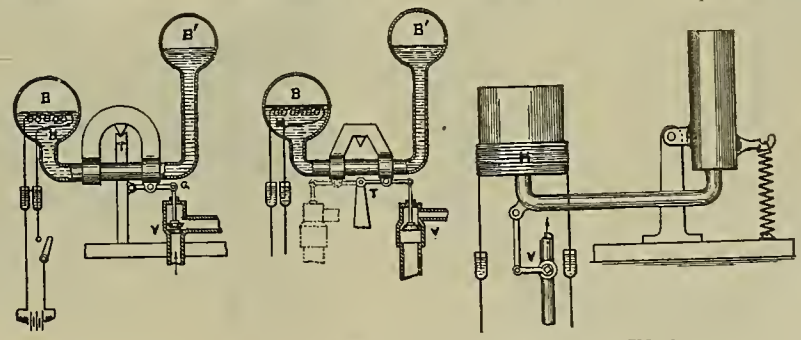


FIG. 1. FIG. 2. FIG. 3.

ELECTRIC VALVE CONTROLLER

through the connecting tubes toward the chamber *B'*, thereby causing that end of the receptacle to tip downward and, by means of the lever *G*, to close the valve *V*. In Fig. 2 the general arrangement of the apparatus is the same, but in this case the valve is to be opened. In Fig. 3 metal boxes are substituted for the glass globes and the heating core is placed on the outside of the receptacle containing the vaporizable liquid.

New Baxter Constant Current Motor.

The accompanying cuts illustrate a new constant current motor which has recently been developed by W. Baxter, Jr., of the Baxter Motor company, Baltimore, Md.

In this new type of constant current motor the inventor regulates the speed by varying the strength of the field magnets to correspond with the changes in the load on the motor—the current in the armature being practically constant.

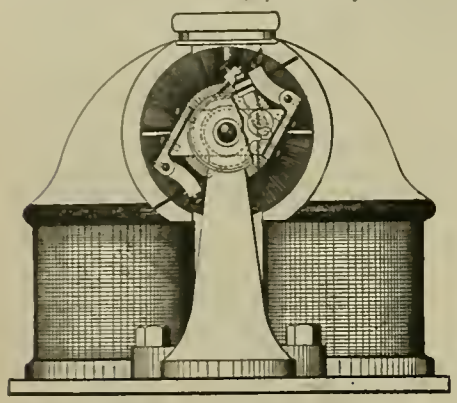


FIG. 1. BAXTER CONSTANT CURRENT MOTOR.

The field magnets are energized by a current shunted from the surface of the commutator by means of a third brush attached to one terminal of the field circuit. By changing the position of this third brush by the agency of a centrifugal governor, the current in the field circuit, and consequently the "pull" of the motor, is made to vary to correspond with the changes in load. The manner in which this current is made to vary in strength, thus causing changes in the intensity of the field, will be understood from the following description of the machine: Referring to the cuts, Fig. 1 shows the general design of the motor. Fig. 2 is a side view of the commutator end of the machine, showing the upper brush and the extra, or third brush, which is the most novel and important feature of the motor. In Fig. 2 is shown the outside of the governor proper. Without going into the details of this part it will suffice to say that a slight increase of speed causes the case or shell, *G*, to move along the armature shaft toward the commutator. As the beveled surface of this shell, *G*, bears upon a roller, *R*, Fig. 2, and as this roller is a part of the swinging lever which carries the third or regulating brush, it will be readily seen that an increase in speed results in the moving of the third brush back toward the top brush of the motor. A spiral spring within the governor shell and a flat spring, *S*, effect the reverse movement when the speed decreases. In order to understand the operation of the various parts illustrated in Figs. 1 and 2, it would be well first to study the connections, as shown in Fig. 3. In this diagram, which represents not only the motor connections, but also a peculiar form of switch which is employed in starting, the lever is shown in the position it occupies when the motor is cut off the line. It might be well also to state that the third or regulating brush, *N*, is represented in the diagram just above one of the two brushes, *M* and *M'*, which are essential to the motor, and also that the coil, marked *K*, is a resistance used only in starting the machine.

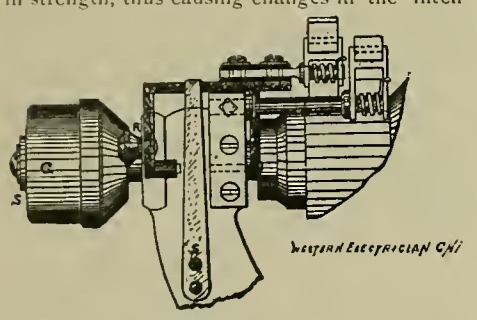


FIG. 2. BAXTER CONSTANT CURRENT MOTOR

To start the motor the operator first moves the handle to contact, *A*. This throws the current into the machine in such a manner that a portion flows through the fields to the third brush, and thence passes out through the armature, while the other portion flows through the resistance, *R*, and also passes out through the armature. A study of this circulation will reveal that under such conditions the motor will have a well energized field as well as full current through the armature. A powerful torque at starting is the result. As soon, however, as the armature reaches a speed sufficient to give it the requisite counter electromotive force to maintain the current in the field independent of the resistance, *R*, the switch lever is moved into such a position that it rests at the same time on both contact *A* and contact *B*. In this position it will be seen that the connections are such that the field circuit is in shunt to that portion of the commutator between the third and top brush. The speed is now maintained constant in the manner already described.

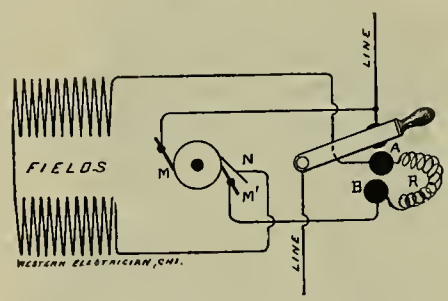
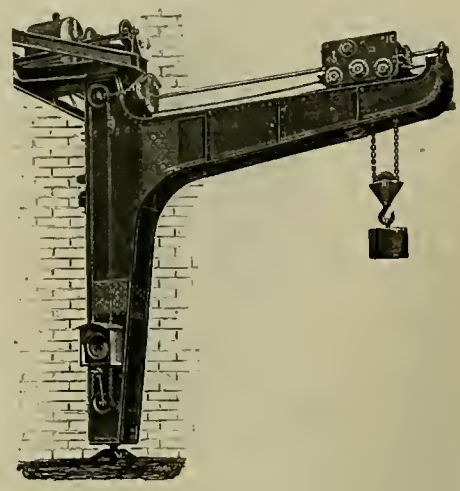


FIG. 3 BAXTER CONSTANT CURRENT MOTOR.

A Theory of Accumulators.

By Dr. Paul Schoop.

In his criticism of my paper on "A Theory of Accumulators," a recent contributor of the Western Electrician has followed the method of killing flies with a shot gun. In writing my paper I was unfortunately obliged to depend for data upon my memory, as I had no memoranda at hand, and in this way a few errors crept in. It is an illustration in point that the specific gravity of the acid referred to in an example in the paper, was incorrectly given. It has been the object of several recent researches to determine the amount of acid set free in an accumulator by the charging current, and to compare the results with the figures worked out by Faraday's law. It has been found that there is a substantial agreement in the figures obtained in these two ways. The quantity of current represented by one ampere-hour deposits .0376 gramme of hydrogen; .300 gramme of oxygen; 3.88 grammes of lead, and .338 gramme of water or 1.870 gramme of sulphuric acid are decomposed in one ampere-hour. A current of 200 ampere-hours decomposes 67.6 grammes of water or 367.2 grammes of sulphuric acid. The 27 pounds of electrolytic fluid of a specific gravity of 1.175 would be raised by the addition of 367 grammes of sulphuric acid to 1.193 specific gravity and not to 1.220. This last figure is the specific gravity of the most concentrated acid used in accumulators, and has the highest conductivity. The hydrogen contained in the porous lead of the kathodes is by weight 7.520 grammes or by volume 84 litres. The weight of the spongy lead in the kathodes of a cell of 200 ampere-hours' capacity is about 2.8 kilos. This figure is based upon the calculations made at the Oerlikon works, Switzerland. The specific gravity of the lead sponge is supposed to be 7. Its volume is 400 cm. Hence the sponge contains about 210 times its own volume of hydrogen. The absorptive power of the lead sponge, as in the case of platinum or palladium, is dependent largely upon the amount of surface presented, upon the degree of division of the sponge and probably also upon other conditions.



ELECTRIC CRANE.

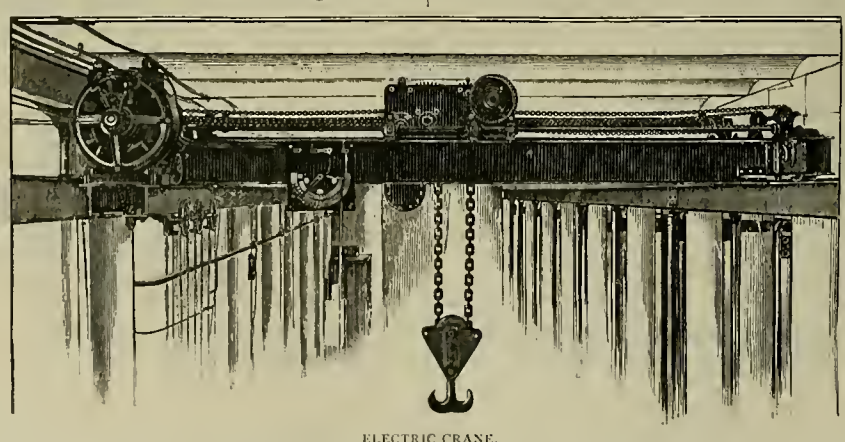
Though the exact figures obtained by calculations do not make it necessary to change the principle of the theory which I advanced three weeks ago, I have given them for the benefit of those who take an interest in the subject.

Electric Light in England.

Much attention has recently been given to the development of electric lighting in England. In this connection the following press dispatch from London will be of interest: "Now that electricity has been successfully shown to possess immense advantages over older methods, both as a motive power and as a luminant, the English, who have been rather slow in accepting the new departure, are demonstrating their faith in its availability by its widespread adoption. One has but to instance the new electric railway, which was opened the other day, and the lighting of the British museum as evidences of the auspicious inauguration of electricity in its chief functions in England. The streets of London have yet to be supplied with the powerful arc lights, but a walk down the Strand or Oxford street after dark will give an idea of the rapidly increasing employment of electric lights by shopmen. Hotels, especially those frequented by Americans, are fully supplied with incandescent lamps, and although far behind New York in this respect, London is coming rapidly to a general use of the brilliant rival of gas. The fact that gas is much cheaper here than in America is almost the sole remaining reason of its supremacy. The electric movement is not confined to the metropolis. Many places in the Kingdom are using electricity, the seaside resort, Brighton, perhaps being in the first rank."

Electric Cranes.

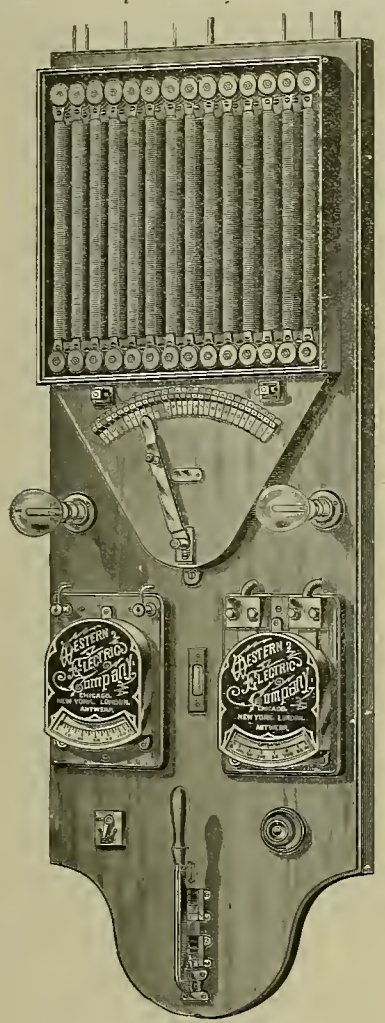
In factories where it is desirable to move heavy machinery, the electric crane is becoming popular. The ease with which the apparatus can be operated and controlled makes its use extremely advantageous. In the accompanying cuts are shown two forms of cranes used in the shops of the General Electrical company in Berlin. They are each available for moving loads of over a ton. They are operated by a 3-horse power, Becker motor. A general idea of the construction of the cranes and of the mode of operating them can be gained by referring to the cuts. The illustrations are reproduced from the *Electrotechnishe Zeitschrift.*



ELECTRIC CRANE.

Combination Switch-Board.

The style of switch-board employed by the Western Electric company in installations in which a single incandescent dynamo is to be operated, is represented in the accompanying cut. Mounted upon a finely finished hardwood



COMBINATION SWITCH-BOARD.

board are the rheostat, ammeter, voltmeter, ground indicator and main switch. All connections are made at the back of the board. The rheostat is not cased as ordinarily. The coils are mounted on porcelain insulators on a cast-iron frame.

Hawkeye Double Pole Cut-out.

A neat and practical double pole cut-out, mounted on a porcelain base and having a porcelain cap, is shown in the accompanying cuts. Fig. 1 shows the inside arrangement of the device. Fig. 2 shows the cut-out, with the cap in position. The cut-out is put on the market by the Central Electric company, Chicago.

The Book Table.

THE ELECTRICIAN ELECTRICAL TRADES DIRECTORY AND HANDBOOK FOR 1890. Published by The Electrician Printing & Publishing Company. London:

This annual is even more complete than any of its predecessors. Besides giving the names and addresses of electrical workers throughout the world it contains a vast amount of valuable information in the way of summaries and statistics. The usual section containing brief biographies of prominent electricians has been amplified, and among the new portraits is a steel engraving of Dr. John Hopkinson.

PRACTICAL ELECTRICAL NOTES AND DEFINITIONS By W. Perren Maycock. Published by E. & F. N. Spon, London and New York. 130 pp. Price 60 cents.

This handy little book is written for the benefit of those who desire a vest-pocket reference book. The definitions are clear and concise. The sections devoted to lightning conductors, units, electro-magnets, dynamos, transmission of power and telpherage include a considerable amount of valuable information in addition to the definitions. Included in the book are the safety rules of the Institution of Electrical Engineers and the Phœnix company. As a handy volume of reference the book is admirably arranged.

SION'S TABLES AND MEMORANDA FOR ENGINEERS. By J. T. Hurst. Tenth Edition. E. & F. N. Spon, London and New York. 140 pages. Price 40 cents.

The scope of this well-known tiny volume is sufficiently indicated by the title. Crowded into its minute pages are tables containing the very information on a thousand and one subjects, which every one desires to know at some time in his life, and frequently finds it difficult to obtain. At such a time this little encyclopædia, whose pages are not much larger than a postage stamp, will prove invaluable.

PRACTICAL ELECTRICS. Published by E. & F. N. Spon, London and New York. 135 pp. Price 75 cents.

The author states in the preface that the volume "is addressed to the very large class of scientific amateurs who dabble in electrical matters." It is intended as a convenient book of reference.

In Honor of Myron D. Law.

The many friends of Myron D. Law, for nine years the superintendent of the Brush Electric Light company of Philadelphia, gave him a banquet at the Colonnade hotel, Philadelphia, on the eve of his departure for Denver. The following gentlemen were present: Myron D. Law, F. A. Lee, J. C. Sager, F. W. Whiting, H. A. Cleverly, J. E. Pentz, W. E. Mellor, C. W. Spear, W. A. Porter, A. J. DeCamp, W. K. Fox, W. A. Drysdale, M.D., C. E. Stump, Wm. McDevitt, L. H. Spellier, A. W. Griffin, H. B. Cutter, W. A. Sherer, J. E. Shaw, W. S. Griffith, W. D. Marks, Dr. Walker, F. R. Colvin.

Letters of regret were read from C. W. Price and W. H. Temple of New York. The toasts were unusually hearty. The first toast to the guest of the evening was: "What is better than good law? Without it we have confusion; with it, all runs smoothly, and system takes the place of disorder. May our guest be a good law unto himself. Parting is pain, but our good wishes attend him. May his new field be a happy one to him, happy to many more, whose happiness depends on him."

This was responded to by H. B. Cutter, who formally presented Mr. Law a handsomely engrossed letter of regret, signed individually by the entire party.

After the response to the toast, "The Electrical Engineer," by F. R. Colvin, A. J. DeCamp was called on, and expressed himself in regard to the loss of one who had worked with him intimately during the last nine years. At the close of his remarks, Mr. DeCamp presented Mr. Law a handsome gold watch on behalf of the officers and directors of the Brush Electric Light company of Philadelphia.

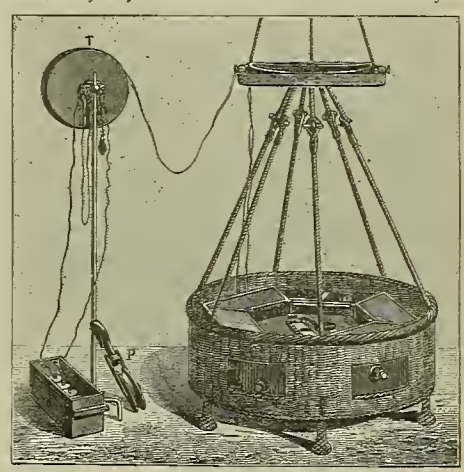
The remaining toasts were responded to by Chief Walker of the Electrical Bureau of Philadelphia; F. A. Lee, Prof. W. D. Marks, William McDevitt, C. W. Spear, F. W. Griffin, C. E. Stump and H. A. Cleverly.

The British Association and the National Electric Light Association.

The London *Electrician* deplores the fact that there is no organization in England corresponding to the National Electric Light association, and presents an excellent review of the work performed at the Kansas City convention as an illustration of the purposes served by that body. There are many points of resemblance between the American institution and the British association, but the latter is not of such a practical character as the former. The *Electrician* says: "Good fellowship is promoted among the members by various kinds of social entertainment, while the numerous papers read at the meetings afford the opportunity for a most valuable interchange of ideas between men drawn from all quarters. The American association is, however, far more commercial in character than either the British association or the Institute of Electrical Engineers. Its delegates are actively engaged in electrical industry, the papers read are very practical in character, and the resulting discussions straightforward and devoid of abstract theory. If busy men can find time to come together in a country of such extent as America, it is strange we have not yet practically recognized the possibility and importance of a similar association here. This might be done by the establishment of an Electrical Engineering Section of the British association. The formation of an Electrical Section of the London Chamber of Commerce is certainly a move in the right direction, although such a body is too local to be altogether satisfactory." It finds many points of interest in the report of the proceedings and commends the action in relation to the standardization of potential especially.

Aerial Photography.

The apparatus shown in the accompanying cut is designed to facilitate ærial photography. A number of interesting experiments have recently been made in this field with excellent results. But is such photography interesting, except as a pastime? Amateur photographers reply in the affirmative. It is frequently desirable, they say, to secure a view of an object



AERIAL PHOTOGRAPHY.

which is absolutely inaccessible, and a photograph may be obtained by the use of apparatus, such as is shown in the cut. It can readily be believed that a practical means of securing views by ærial photography might prove of great utility in military operations. The apparatus shown in the illustration, which was devised by M. Triboulet, consists of a captive balloon, in the car of which are arranged six boxes containing cameras with lenses projecting through the sides of the car. A seventh camera is located in the center of the car commanding a view directly under the balloon. The shutters of the cameras are connected by flexible cables to a dry battery. The cable is paid out as the balloon rises from the reel shown at *T*. When the balloon reaches the desired height the plates may be exposed by pressing a button. A series of panoramic pictures and a bird's eye view are obtained. The cut is reproduced from *La Nature*, which states that ærial photography is bound to have an interesting future.

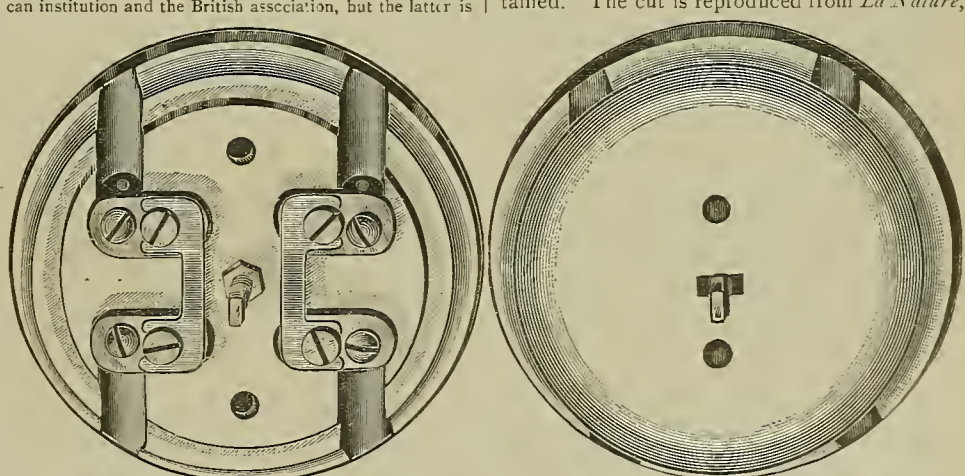


FIG. 1. HAWKEYE DOUBLE POLE CUT-OUT. FIG. 2.

The Newark (N. J.) city council recently granted permission to the local street car company to change its lines to an electric system, but some of the slow going residents object to the introduction of rapid transit. The council wisely overlooked their objections and the old fogies have invoked the aid of the legislature to nullify the action of the council. The subject is now under consideration.

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THE Boston letter contains an abstract of the annual report of the American Bell Telephone company. The figures make a splendid showing. There are in use in the United States at the present time almost a half million instruments, and the total number of calls aggregates 400,000,000 per year.

THE "reform" movement which appears in every large city just before election induced the Chicago aldermen to call upon the law department for an opinion on the question of the right of the city to exact a tax or license fee from the telephone company for each instrument in use. Assistant Corporation Counsel Darrow says the city has no right to do this, and he has accordingly notified the aldermen to that effect.

IN another column is presented an article by Nelson W. Perry on the subject of putting conductors underground. The paper was presented for the enlightenment of a senate committee of the Ohio legislature. Mr. Perry believes that the problems connected with burying wires are soluble. The keynote of the article is found in these sentences: "There are some dangers from electric wires that will exist whether they be buried or placed on poles, but I do not think of any new ones that are introduced by putting them underground. There are certainly many causes of danger removed by so doing."

ELSEWHERE in this issue is presented in substance the opinion of Justice Blatchford of the United States Supreme court on an important patent case, just decided, in which it is established that United States patents are not affected by the lapse of foreign patents for the same invention, by reason of failure to pay the tax required by the foreign government. The United States patent, it is decided, is good to the full end of the original term of the foreign patent, though the latter becomes void or lapses for any reason prior to the end of its original term. This question was in controversy when the Bate Refrigerating case was decided a year ago. Then it was held by the *Electrical Engineer* that this was not the correct interpretation of the patent law. Many prominent patent lawyers sustained this position, and rulings were made by Judge Wallace of New York and Judge Thayer of St. Louis on the same line. A case was appealed to the Supreme court for a ruling, and it will be seen from the opinion published elsewhere that Judge Blatchford takes the same view of the case as this journal, and has reversed the decision of Judge Wallace, from which the appeal was taken.

THE question of what constitutes a model city has been treated by a number of writers recently. It seems to be generally agreed that the plan of a municipality to be a model must embrace a scheme of disposing of electric conductors. A recent writer says that if any competent engineer were to draw a comprehensive plan for development of a city, he would make his arrangements in such a way that the pipes for water and gas and the wires for electric service should be placed in a culvert under the street, with an opening two or three feet wide that could be easily uncovered without disturbing the pavement on either side. Even if the development of a city could be foreseen, it is little likely that any city councillors would be willing to pay for culverts for the use of future generations, especially if the cost of construction were as great as the figures given in the recent paper read by Mr. Maver before the Institute of Electrical Engineers. According to his estimate a tunnel large enough to contain the wires used in a great city would cost about half a million dollars per mile. Of course, such an amount is practically prohibitory of this scheme of disposing of wires, even for the present generation.

CONSIDERABLE space is devoted in the New York letter this week to the report of the senate committee investigation of electrical interests. This inquiry naturally has attracted much attention. The fact that the members of the committee knew absolutely nothing about the subject which they had under consideration, of course proved a drawback, but through the good offices of an able expert they managed to secure much valuable information. The committee says: "We do not think it possible for the legislature to form satisfactory rules and regulations for application to an industry that is not only highly technical, but constantly developing and presenting new conditions." It recommends, however, "First, that no electric light or power current of over 250 volts' pressure be allowed to enter any building; second, that after, say January 1, 1892, no overhead conductors carrying currents for lighting or power purposes be allowed in any street, highway or public place in any city of the state having a population of 125,000 persons or over, and that the local authorities in the various cities coming under this description, in the absence of any state authority, be empowered and directed to make proper provision for the burial of such wires." A bill is now in preparation providing for these regulations.

It is evident from this that the committee made an effort in the right direction. Without being hypercritical, however, in regard to a wire "carrying 250 volts," or dwelling upon the fact that the committee made suggestions after having admitted that "they did not think it possible for the legislature to form satisfactory rules and regulations," one naturally wonders at the exact meaning of the restrictive expression in regard to voltage. The fact that six arc lamps, each working at a difference of potential from terminal to terminal of 40 volts, might be operated in a building, and there still exist in that building a potential of only 240 volts, would seem to indicate that the opening statement of the summary of the report, given in the New York letter, was correct. The committee evidently realizes its position. It is hardly necessary to point out that this general suggestion apparently relieves the committee of future responsibility.

AN interesting and thoroughly practical paper by Dr. Louis Duncan and W. F. C. Hasson on "Some Tests on the Efficiency of Alternating Current Apparatus," is presented in this issue. The paper was recently read before the American Institute of Electrical Engineers. The tests referred to were made by the authors at the Johns Hopkins university. Referring to the results obtained, which are presented in tabulated form, Dr. Duncan points out among other things what a very large amount of power is absorbed in the armature and what a comparatively small loss there is in the converters when working on an open circuit. After giving the results of the tests, the authors consider comparatively a continuous and an alternating system. They also point out the fact that, owing to the great difference in the territory which is, as a rule, necessarily supplied by the two systems, it is hardly fair to make comparisons. Dr. Duncan is of the opinion that unless the losses in converters can be greatly decreased, a house-to-house distribution with a converter in each house would hardly pay. If gas is to be really displaced, "we must," says Dr. Duncan, "replace the numerous small converters with one large converter, supplying a comparatively extended district." Practical designers of converters will do well to study the last portion of the paper.

THE World's Fair is to be held in Chicago, and very sensibly Congress has postponed the great exposition until 1893. Three years is certainly a short enough time in which to prepare for an exhibition of such magnitude. Foreign nations seem to think it will be utterly impracticable to complete the arrangements by 1893, but the Chicagoans who have the enterprise in charge, are now thoroughly satisfied with the time at their disposal. They assert that three years will afford them ample opportunity for arranging the grandest international exposition that the world has seen. We have already expressed our belief that the electrical section of the fair will be its most significant feature. An abundance of time is now given to the representatives of American electrical interests to prepare for the great event. It is hoped that they will heartily co-operate in making the electrical exhibition a striking demonstration of what they have accomplished in the last few years. In the course of time a commissioner will doubtless be appointed to take charge of the department of electricity. His responsibilities will be manifold and his labors will be of the most arduous character. The selection of this official should be made with the greatest care. Whether the electrical department is to be excellent or indifferent will, to a great extent, depend upon the capacity or incapacity of this commissioner to discharge the onerous duties of his important office. Before the selection is made the opinions of electrical workers throughout the country should be as far as possible consulted, for the officer should be a man whom they know thoroughly, and in whose judgment they have entire confidence. We advert to the subject in order that it may be brought to the attention of the electrical fraternity, and that during the next few months they may give the question of this important appointment the thought that it deserves. The appointee should be a sound, practical man, with an international reputation.

Some Tests on the Efficiency of Alternating Current Apparatus.[1]

By Dr. Louis Duncan and W. F. C. Hasson.

Several papers have appeared lately on the efficiency of alternating current transformers, some of which have been of a more or less theoretical nature, while others have given the results of actual tests. I have never, however, seen any tests on alternating current dynamos, excepting the experiments made by Dr. Hopkinson and Professor Adams on a de Meritens machine used for lighthouse work. Even the converter tests have given such varying results that one can hardly be certain as to the real efficiency.

The introduction of the alternating system has been so rapid and is so rapidly increasing that people are apparently well enough pleased with the results not to bother about the smaller question of the reasons for them. But whatever the results may be it is of value to know just where the losses in any system may come in, so that we may seek how to avoid them; if we are succeeding it may enable us to increase the profits—if we are losing it may help us to avoid further loss.

The apparatus, the measurement of which is the main subject of this paper, consisted of a Westinghouse 750-light No. 1 dynamo, with a No. 2 exciter and an outfit of 40-light converters. This apparatus has been presented by the Westinghouse Electric company to the Johns Hopkins university, and was tested a couple of months ago. The workmanship of the machines is excellent.

The plant consisted of a 75 horse power Armington & Sims' engine driving the dynamo and exciter through a Tatham transmission dynamometer. Engine, dynamometer and dynamos were firmly secured to heavy parallel timbers which served as a foundation. The converters were banked on a wooden framework at a distance of some thirty yards from the dynamo, and their primaries were permanently secured to the dynamo circuit, a switch in the latter serving to cut them off when desired. The ammeter belonging to the plant was put in this circuit and was read when efficiency measurements were being taken. The secondaries of the converters were taken to a switch-board and then to incandescent lamps mounted on racks.

Power Measurements.—The Armington & Sims' engine supplying the power worked regularly and satisfactorily, and the governor could be adjusted to give the speed required at the dynamo. The Tatham dynamometer was the one used for power measurements at the International Electrical exhibition, held in Philadelphia, in 1884, where its accuracy was checked by making with it a determination of the mechanical equivalent of heat. The result obtained in the latter measurement was 772.8 foot-pounds

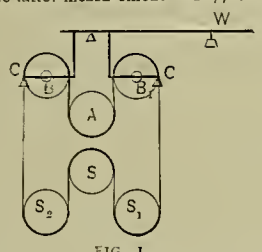

FIG. 1.

per degree Fahr., and shows that the dynamometer is practically accurate. A description of the experiments and of the instrument may be found in the report of the test made to the Franklin institute, but it will not be out of place to briefly describe the apparatus here.

An endless belt, as shown in Fig. 1, passes over the driven pulley, S to the shaft of which the engine is belted, round the pulleys, S_2 and B, to the driving pulley A and back over B_1 and S_1, to S again. The bearings of the pulleys B and B_1 are in cradles pivoted on knife edges, C, at their outer ends and at the inner ends are connected by links at equal distances on the two sides of a knife edge which supports the scale beam, W. The outer side belt passes through the line of the knife edges, C, and therefore has no effect on the scale beam, but the tensions of the inner parts of the belt act directly on the scale beam, and as they are on opposite sides of the fulcrum they act against one another. The beam is so graduated that this difference of tension is read off directly in pounds, and this quantity—the difference of tension of the belt on the two sides of A—multiplied by its circumference and speed, gives the horse power delivered. A weight travels on the beam, W, and readings can be taken with great accuracy.

Electrical Measurements.—The energy in the secondary circuit was measured by means of a Cardew voltmeter and a Thomson ampere balance. As it is not the custom to put a number of secondaries in parallel, each converter had its separate lamp circuit.

Before making an efficiency test, the potential difference in the primary was regulated—there being a Cardew voltmeter in that circuit, and a separate measurement of the potential difference and current in each secondary circuit was made. When the test was actually in progress the voltmeter and ampere balance were used in one of the circuits and the currents and potential differences in the others were calculated from the readings in this circuit together with the previous measurements. Both the voltmeter and ampere balance were accurately calibrated, the former being checked after each test, while the latter had its constant determined with both continuous and alternating currents. The potential difference at the terminals of a non-inductive German silver resistance in circuit with the balance was observed, when a continuous current was flowing, and also with an alternating current of the same period as that employed in the test. The current in each case was calculated from the resistance and potential difference, and the results gave no appreciable difference in the constant for continuous and alternating currents.

[1] Read by Dr. Duncan before the American Institute of Electrical Engineers, March 18, 1890.

The following tables show at once the order in which the tests were carried out and the results:

HORSE POWER ABSORBED AT VARYING E. M. F.'S.

	E. M. F.		H. P.
	Dyn'mo	Exciter	
Horse power for exciter, field not made	0	0	·34
" " " field made	0	110	·75
" " dynamo alone	0	0	2.73
" " dynamo and exciter	0	0	3.04
" " " " "	0	107	3 51
" " " " "	1376	124	12 5
" " " " "	1168	104	10.1
" " " " "	1069	105	9.60
" " " " "	1040	105	9 0
" " primaries of converters on	1216	105	12 0
" " " "	1171	104	11.8
" " " "	1 07	104	11.12
" " " "	1048	104	10.64

TABLE OF EFFICIENCY OF VARYING LOADS.

Approximate load.	Exciter. E. M. F.	Exciter. Current	Dynamo primary. E. M. F.	Dynamo primary. Current	Converters. E. M. F.	Converters. Current	Horse power in lamp circuit.	Mechanical horse power.	Loss in horse power.	Efficiency.
¼	105	9.4	1107	1.	49 5	153.9	10 21	21.83	11.62	46.8%
½	104	10.5	1107	189	49 6	338.4	22 50	34 4	11.50	65.4%
¾	101	11.	1113	28 6	50 0	520.7	34.9	48 0	13.1	72.7%
Full	112	11 5	1123	38.1	50.9	730 8	50.58	64.44	13 96	78.3%

EFFICIENCY OF CONVERTERS

No. 8. 40-light converter.

No. of lamps.	Volts.	Watts in second'ry.	Loss in Watts.	Loss in iron.	Efficiency.
40	50.0	2001	109	.....	94.8
0	50.9	0	84	84	

No. 4. 20-light converter.

No. of lamps.	Volts.	Watts in second'ry.	Loss in watts in second'ry.	Loss in iron watts.	Efficiency.
20	48.8	952	106.	95.2	90.0%
15	52 2	817	114 8	118.9	87 6%
10	50 3	505	101.7	99.2	83.3%
5	51.44	264	109.4	108.7	70 7%
0	52.3	0	110.5	110 5	0. %

The efficiency of the converters was measured by placing them in a metal calorimeter, between the double walls of which water was allowed to flow. The temperatures of exit and entrance were observed, as well as the weight of water which passed through; at the same time the current and p. d. in the secondary circuit of the converter were measured. A separate observation gave the radiation, which was of course allowed for, although it was made as small as possible. A number of converters were experimented on, but I give but two of them; a 40-lighter, such as was used in the tests, and a 20-light converter which was very carefully tested by two of my students, Messrs. Bliss and McKean. In the latter case the observations were made at slightly different p. d.'s, and the results show that the loss in the iron varies as we would expect it to vary, that is, very nearly as the square of the voltage. The variation will not be exact, as the losses due to the reversal of magnetism do not vary quite as fast as the square of the induction.

I would like here to call attention to the fact that in an excellent paper read before this institute, Professor Ryan of Cornell, found that the losses in the iron of a 10-light converter decreased greatly as the load increased. This was accounted for by the fact that there was a jar (evidenced by the singing of the converter) at the higher loads, due to the attractions of the secondary and primary coils. While it is true that the losses in the cores of very small converters are not exactly constant, yet they are nearly so, and a large part of the decrease found by Professor Ryan is due to the voltage being greater at the low than at the high loads.

Looking now at the figures given in the tables we are struck by two things; the very large amount of power absorbed in the core of the armature, and the very small loss in the converters on open circuit. The dynamo losses due to reversal of magnetism and eddy currents, at the e. m. f. used in the test are no less than six horse power, while the energy due to reversal of magnetism and eddy currents in the 16 converters is only 1.6 horse power. Another rather striking thing is the almost constant ratio of primary and secondary currents over a considerable range. The maximum efficiency is about 78 per cent. It would seem that the losses could be divided into a constant part, and one varying with the current, but this is not true with the older style and smaller converters of the Westinghouse company.

Suppose we have a plant such as is described above, and use it for commercial lighting. Taking data from one of the local companies employed in supplying incandescent lights on this system we have, for two 2,500 light dynamos, the following outfit of converters:

Size of Converters.	Capacity.	Number in use.	Total Lamps.
No 1.	5 16 c. p. lamps.	44	220
No 2.	10 " " "	61	610
No. 4.	20 " " "	43	860
No. 6.	30 " " "	49	1,470
No. 8.	40 " " "	64	2,560
Total lamp capacity			5,720
Number of lamps supplied			4,557

I understand that the converters being added are of the larger sizes.

The efficiency of the 30-light converters does not differ greatly from that of the 40-lighters. The following is a load diagram of this plant, selected from a number of diagrams as giving a fair average curve. If we have our dynamo working to its full capacity then from the above data we would have a converter capacity of twenty-three 40-light converters.

If, as in our test plant, these converters are 40-lighters, or 30-lighters—for the efficiency of these two sizes is about the same—we would have a mean loss in in our plant, say, 10 horse power in our dynamos ($9.6+C^2R$), and in the converters about 3 horse power ($2.3+C^2R$); or all together about 13 horse power. From the above table we will have 750 lamps supplied, and taking the data from the load curve the average load would be in the neighborhood of 1,300. This corresponds to about 20 horse power and the efficiency of the plant for 24 hours would be $\frac{23}{33}$ = 61 per cent., minus the percentage of loss on the lines. This, in a properly installed system, should not average 2 per cent., so that the final efficiency would be 59 per cent.

A continuous current dynamo supplying the same outfit of lamps, with a maximum loss in the mains of, say, 15 per cent., would have a greater average efficiency. But I wish to point out that the maximum efficiency of the two plants would be about the same, so that they would require the same capacity of station outfit, boilers, engines and dynamos, etc. When more than one dynamo is provided the efficiency is increased by using only one of them during the times of minimum supply, and always working as far as possible only a little below the maximum capacity of the machines.

Let us consider these results in view of the present condition of incandescent light distribution in the United States. I take it that what may be called domestic electric lighting is largely a matter of the future—it is certainly not a matter of the present. The majority—the great majority—of the lights in use are in shops, saloons, theaters, offices, etc. Most of the lights wired are in use at one time or another during the 24 hours, and the proportion of energy supplied to the total capacity of the lamps connected is much greater than it would be in the case of house lighting, where, on the average, only a small fraction of the possible lamp-hours are actually in use. Under these circumstances the scheme of alternate current distribution is very different from what it will be when the attempt is made to supply an entire city with light, as they are attempting to supply London at the present time.

If the object of the lighting company is to supply the demand that exists at present, then a system employing a

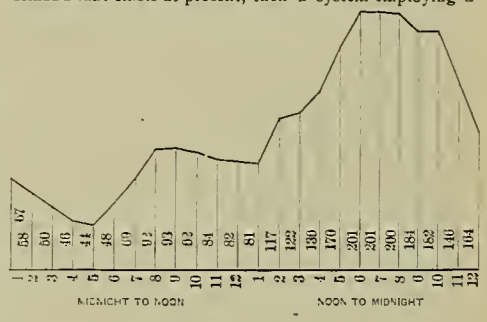

FIG. 2.

number of small converters is preferable. Such a system is flexible, and can be installed with a minimum expense for the more or less scattered demand which is presented in even the most closely settled town. I take it that this is the great difference between the alternating and direct systems as at present installed in this country. The former skims over an extended district, taking advantage of the great flexibility to absorb any business which can be got; while the latter settles itself in a densely built center, installs a larger plant than is primarily demanded, and works up a business within the limits of economical distribution. Therefore, it is hardly right to compare the present systems of direct and alternating supply, as the latter has not been reduced to a point where entire districts are to be supplied.

To show the disadvantage of the present system for domestic supply, suppose we have an ordinary house such as one of us would live in; it would be necessary to have a converter of at least 20 light capacity. The constant loss is, say, 100 watts; so, leaving out the C^2R loss, we would have a total loss in 24 hours, of $\frac{2400}{100}$, or about 3-horse power hours, corresponding to, say, 45 lamp-hours. Taking my own experience the actual number of lamp hours used is about 30 lamp-hours during 24 hours, so the efficiency of the converter would be something like $\frac{30}{75}$ = 40 per cent. It is evident that unless the losses in converters can be greatly decreased, a house-to-house distribution with a converter in each house would hardly pay.

It would seem, then, that if gas is to be really displaced and serious competition with it is to be attempted a different system of distribution must be worked out. We must replace the numerous small converters with one large converter, supplying a comparatively extended district, thus decreasing the converter capacity, since the law of average can be taken advantage of, and greatly increasing the efficiency. If an extended secondary network is employed some of the converters may be disconnected from the mains at the turn of minimum demand.

Let us inquire for a moment how the increase in the capacity of converters will modify the designs with which we are familiar. In the first place, if we increase the linear dimensions of any type, since the radiating surface only increases as the square while the volume increases as the cube of the dimension, then we cannot suffer the same loss per cubic centimeter of the iron for the large as for the small sizes. We must decrease the intensity of magnetization or we must decrease the periodicity.

Let us take a typical case. Suppose we have a trans-

former and double all of its dimensions. If we employ the same induction we will need but one-quarter the number of turns in the coils, and as the cross-section of the space occupied by the wire is four times as great, the area of the wire may be sixteen times as much. As the length is twice as great the resistance in this case is one-eighth. But the losses in the iron are roughly, eight times as great; this we cannot allow, since the radiating surface is but four times as great; hence we must diminish the induction. In fact, we must so arrange things that the loss in the larger converter is only four times that in the smaller, in order to work at the same temperature. As at the low induction used the loss due to hysteresis varies nearly as the square of the induction, we may take it roughly that the large converter should have an induction of three-quarters of the smaller one. This will modify our figures. Instead of one-quarter the number of turns we will have one-third, and the resistance of the coils will be one-sixth instead of one-eighth, as we can allow four times the loss that we suffered before we can have, roughly, five times the output.

As a total result we have five times the output with four times the loss, or, as the C^2R effect is not important as compared with the other losses, we can have six times the output with the same fall of potential in the secondary. That is, the efficiency of the larger converters will be greater than the smaller ones of the same design, and working at the same temperature, but the output per pound of metal will be less.

Suppose when we increase the size we decrease the number of reversals. Take a case, for instance, in which the dimensions are doubled while the reversals are halved, the maximum induction remaining the same. We could have half the turns in the coils, and as they occupy four times the space and are twice as long, the total resistance would be one-quarter, and for the same heating effect we would have four times the output.

If we take losses by eddy currents into account there will be a constant per cubic centimeter, provided the period and maximum induction are constant and the thickness of the plates is unchanged; otherwise they will vary as the square of the induction, with a constant frequency, or inversely as the square of the period with a constant maximum induction. This in practice would make the values of the output for the larger currents given above, somewhat greater. What I wish to show, however, is that we are limited by heating considerations and considerations of fall of potential in our secondary in the output of large converters. If we consider the properties of the materials of which converters are made we would, I think, find it most economical to make converters that reach the temperature limit, except for the very smallest sizes.

Many of us have, I suppose, read James Swinburne's paper read before the British association at Newcastle last year on the "Design of Converters," and have been struck by the fact that almost all of the converter dimensions given by him are impracticable, either on account of the disproportionate heating of the larger sizes, or the excessive fall of potential in the secondary. In increasing the size of dynamos we usually increase the output per pound weight, but there is the vital distinction between dynamos and converters that losses occur through the entire mass of the latter, and as we increase the volume we increase the losses in the same proportion. In the dynamo, on the contrary, there are practically no losses in the heaviest part of the apparatus, *i. e.*, the field magnets. As a result, while we gain in efficiency in the larger sizes, yet we must decrease either our induction or the rate of reversal, and the output per pound is not increased.

Volts and Horse Power Lost in a Mile of Copper Wire.

In arc lighting and series incandescent lighting it is often very desirable to ascertain how many volts or how many mechanical horse power are lost in one mile of copper wire. Purchasers of electrical apparatus generally wish to learn at what loss they can successfully and economically operate arc light lines or series incandescent lines. For this purpose the accompanying table has been calculated, giving at a glance the required data.

Suppose an arc light 10 ampere current is to be distributed along a six-mile circuit of No. 6 B & S wire. In the table at the intersection of the two columns, "10 amperes" and "6 B & S," we find 20.9 volts and .336 horse power. In six miles we would lose $20.9 \times 6 = 125.4$ volts and $.336 \times 6 = 2.016$ mechanical horse power.

In a series system with incandescent lamps requiring 3½ amperes of current, there is to be distribution over 10 miles of circuit of No. 12 B & S copper wire. We find that we lose 293 volts and 1.65 mechanical horse power. In finding such data, the table will be found to be extremely useful.

GAUGE No. B & S		— AMPERES —																												
		1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
12	V	8.4	12.6	16.8	20.9	25.2	29.3	33.6	37.7	41.9	46.1	50.4	54.5	58.8	62.9	67.2	71.3	75.5	79.6	83.9	92.3	100.7	109.1	117.5	125.9	134.2	142.6	151.0	159.4	167.8	176.2	184.6	192.9	201.4	209.8
	HP	.014	.020	.054	.084	.121	.165	.216	.273	.337	.408	.486	.570	.661	.759	.864	.975	1.093	1.215	1.350	1.633	1.944	2.281	2.646	3.037	3.456	3.901	4.371	4.873	5.400	5.953	6.534	7.141	7.776	8.437
10	V	5.3	7.9	10.6	13.2	15.8	18.5	21.1	23.8	26.4	29.0	31.7	34.3	36.9	39.6	42.2	45.8	47.5	50.2	52.8	58.1	63.4	68.6	73.9	79.2	84.5	89.8	95.0	100.3	105.6	110.9	116.2	121.4	126.7	132.0
	HP	.008	.019	.034	.053	.076	.104	.136	.172	.212	.257	.305	.358	.416	.477	.543	.613	.687	.766	.848	1.026	1.222	1.434	1.663	1.909	2.172	2.452	2.749	3.063	3.395	3.741	4.106	4.488	4.887	5.302
9	V	4.2	6.3	8.4	10.5	12.6	14.7	16.8	18.9	21.0	23.1	25.2	27.3	29.4	31.5	33.6	35.7	37.8	39.9	41.9	46.2	50.4	54.6	58.8	63.0	67.2	71.4	75.6	79.8	84.0	88.2	92.4	96.6	100.8	104.7
	HP	.007	.015	.027	.042	.061	.082	.108	.136	.168	.204	.242	.284	.330	.379	.431	.486	.545	.608	.673	.815	.969	1.138	1.319	1.515	1.725	1.945	2.061	2.430	2.693	2.969	3.258	3.696	3.879	4.207
8	V	3.3	5.0	6.6	8.3	9.9	11.7	13.3	14.9	16.6	18.3	19.9	21.6	23.2	24.9	26.6	28.3	29.9	31.5	33.2	36.5	39.8	43.2	46.5	49.8	53.1	56.4	59.8	63.1	66.4	69.7	73.0	76.4	79.7	83.0
	HP	.005	.012	.021	.033	.048	.065	.085	.108	.134	.162	.192	.226	.262	.300	.342	.386	.433	.482	.534	.646	.769	.902	1.047	1.201	1.367	1.543	1.730	1.928	2.136	2.355	2.585	2.932	3.076	3.337
7	V	2.6	3.9	5.3	6.5	7.9	9.2	10.5	11.8	13.2	14.5	15.8	17.1	18.4	19.7	21.0	22.3	23.7	24.9	26.3	28.9	31.6	34.2	36.8	39.5	42.1	44.7	47.3	50.1	52.6	55.2	57.9	60.5	63.1	65.8
	HP	.004	.009	.017	.026	.038	.052	.068	.086	.106	.128	.152	.179	.208	.238	.271	.306	.343	.382	.424	.513	.609	.716	.830	.953	1.084	1.224	1.372	1.529	1.694	1.868	2.050	2.243	2.448	2.647
6	V	2.1	3.1	4.2	5.2	6.3	7.3	8.4	9.4	10.5	11.5	12.5	13.6	14.6	15.7	16.7	17.7	18.8	19.9	20.9	22.9	25.1	27.2	29.3	31.4	33.4	35.5	37.6	39.7	41.8	43.9	45.9	48.1	50.2	52.3
	HP	.003	.008	.011	.021	.030	.041	.054	.068	.084	.102	.121	.142	.165	.189	.215	.243	.272	.303	.336	.407	.484	.568	.659	.756	.860	.971	1.089	1.213	1.344	1.482	1.626	1.845	1.938	2.100
5	V	1.7	2.5	3.3	4.2	4.9	5.8	6.6	7.5	8.3	9.1	9.9	10.8	11.6	12.5	13.3	14.1	14.9	15.8	16.6	18.3	19.9	21.6	23.2	24.9	26.6	28.2	29.9	31.5	33.2	34.9	36.5	38.2	39.8	41.5
	HP	.005	.006	.011	.017	.024	.033	.043	.054	.067	.081	.096	.113	.131	.151	.171	.193	.217	.242	.268	.324	.385	.452	.524	.602	.685	.773	.867	.966	1.070	1.180	1.295	1.469	1.541	1.675
4	V	1.3	2.0	2.6	3.3	3.9	4.6	5.2	5.9	6.6	7.3	7.9	8.6	9.2	9.9	10.5	11.2	11.8	12.5	13.1	14.4	15.7	17.0	18.3	19.7	20.9	22.3	23.6	24.9	26.2	27.5	28.8	30.1	31.4	32.8
	HP	.002	.005	.008	.013	.019	.026	.034	.043	.052	.064	.076	.089	.103	.118	.134	.152	.170	.189	.210	.254	.302	.355	.412	.472	.538	.607	.680	.758	.840	.926	1.016	1.153	1.209	1.313

VOLTS AND HORSE POWER LOST IN A MILE OF COPPER WIRE.

Electric Heater.

The accompanying cuts illustrate a form of electric radiator which has recently been patented by H. R. Butterfield and W. Mitchell of Waterville, Me. Fig. 1 represents the heater as it appears when ready for use. In the other cut, Fig. 2, the device is shown with the exterior casing removed. This apparatus was designed

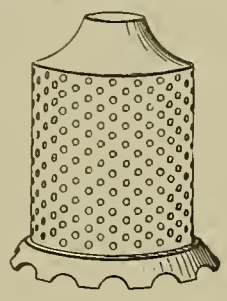

FIG. 1.

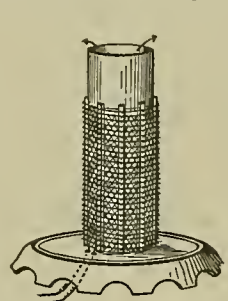

FIG. 2.

ELECTRIC HEATER.

with a view of providing a simple electric heater suitable for warming rooms, halls, etc. As will be noticed the wire which is heated by the passage of the current is wound on frames or supports in such a way as to form a wire network. This netting allows a free circulation of air about itself, but is arranged in circuit as a continuous conductor.

Gas and Electric Light.

It is a fact worthy of note that the so-called gas journals of the country are giving considerable attention to the development of electric lighting—in fact, the recent numbers of many of these journals are about equally divided between the electrical and gas interests. Moreover, representatives of the gas interests throughout the country whenever they meet in convention, devote about as much time to the consideration of electrical problems as the gas business. As an example, the following abstract of an address by President Henry Peaty to the Midland Association of Gas Engineers, reported in a gas journal, is presented: "During the past year many things have happened which compel us to examine seriously the conditions of stability of our gas undertakings. Our rivals, if they have not actually increased in number, have developed in strength and activity. Some of them may be passed by without much consideration; to others, we must give our respectful attention. The language used formerly in describing electric lighting, and in estimating its value and prospects of success, must be considerably modified. Many of the defects which have been pointed out in past years, no longer exist; and those that remain have the attention of accomplished engineers, who are exerting every energy to effect their removal. We can no longer speak of the impossibility of bringing the light down to an illuminating power that would be generally useful; that it does not admit of regulation; that it is variable and uncertain (I am now speaking of the glow lamp supplied from accumulators); and that the color is more trying and wearying to the eyes. In many respects, it is a most beautiful light; and the way in which it can be adjusted to any portion of a room ornamenting as well as illuminating—commends it to those who have a delight in beautiful adaptations, and who are not confined to the economical aspect alone. At present it cannot compete with coal gas in economy; it is to some extent a light of luxury. But many people like luxurious appliances, and can afford to have them. There is such a thing as fashion. What is fashionable will be sought after; and in many places, good and useful as gas has proved itself to be, and still is, the newer light will find a place. The gas will be removed, or relegated to the humbler offices of the house or mansion. Any one who has money and taste enough to adorn his principal rooms with valuable pictures and other decorations, would not hesitate to illuminate them, wherever practicable, with the light that would least interfere with their valuable contents."

Municipal Control of Lighting.

In a paper read before the Ohio Gas association on "Municipal Control of Lighting," H. Wilkiemeyer said: "The capital of a city is derived primarily from the pockets of the people; secondarily, from the vaults of the city treasurer. It is not an exercise of solid political economy to allow the people's money to be invested in a commercial undertaking," and "no man should be willing to be taxed in order that a city should secure capital with which to strangle private enterprise." In commenting on this, a contemporary says: "If the political stranglers who are now agitating for the supply of gas and electric light by the cities and towns of Massachusetts could, through the medium of the constituents whose interests they misrepresent, be shown the potency of this argument, they might not be so willing to engage in an attempt through corporate force 'to strangle private enterprise.' Labor cannot look to its just due from public employment, for private capital has always been its saviour."

Arguing for a Postal Telegraph.

The discussion at Washington over the establishment of a postal telegraph system was continued last week. Gardner G. Hubbard concluded his argument Tuesday, when he contended that the telegraph companies had built their lines and maintained them out of the tolls of the public, and therefore had no right to their plant. He continued: Since 1864 the telegraph companies had collected $1,250,000,000 from the people. Their net profit was $97,000,000, and a surplus of $8,000,000 remained. The establishment of a government telegraph, he believed, would not interfere with the business of the Western Union company. The government business would be largely social, while the Western Union would do a stock jobbing and gambling business. There were two systems proposed, said Mr. Hubbard. These were the postal system and the system of private companies. It had been proved in England, where both systems had been tried, that the government system was in every way better. The English government had paid about $50,000,000 for the private lines. F. B. Thurber, representing the New York Board of Trade, also argued in favor of the establishment of a postal telegraph. He wished to rebut the statement of Dr. Green that nobody who patronized the telegraph cared for the establishment of a government system. There had been no question so generally discussed and none so generally approved by the National Board of Trade. Mr. Thurber read a resolution adopted by the National Board of Trade, asking Congress to establish a postal telegraph system. Mr. Thurber stated that he had written to commercial institutions in England concerning the workings of the postal telegraph system in that country, and had received answers that caused him to believe that a similar system could be operated successfully in this country. The English system, while it had not been satisfactory to the Postoffice department, had been satisfactory to the people. In conclusion, Mr. Thurber stated that he believed the Wanamaker bill was a step in the right direction, and he read a resolution adopted by the New York Board of Trade recommending the passage of the measure.

The following officers of the Green Lake Electric Railway company have been elected at Seattle, Wash.: President, W. D. Wood; vice-president, James Leddy; secretary, C. E. Chapin; treasurer, V. Hugo Smith; manager, Dr. E. C. Kilbourne; trustees, W. D. Wood, E. C. Kilbourne, James Leddy, L. H. Griffith, V. Hugo Smith.

Report on Alternating Current Arc Lamps and Continuous Current Transformers.

It will be remembered that in the last two issues of the WESTERN ELECTRICIAN there were presented abstracts from a report made by a commission of experts appointed by the municipal authorities of Frankfort-on-the-Main, Germany. The last abstract pertained to comparative tests with alternating and continuous current arc lamps. The continuation of this latter portion of the report was as follows:

"This inferior performance of the alternating current arc lamps is compensated in their use for illuminating shops, halls and streets, by the circumstance that they require a considerably lower tension—less by 20—30 per cent.—than do continuous current arc lamps. Thus the alternating lamp used to light one of the shops required a tension of 32—35 volts between its carbons, while the Schuckert continuous lamp, acting with the same consumption of energy, required a tension of 43—44 volts between the carbons. Hence, in an installation with a tension of 105 volts, which permits the insertion in series of only two continuous current arc lamps, three alternating current arc lamps may be inserted in series, and may work up to 8 amperes.

"The frequent change in the direction of the current occasions, in the alternating lamps, a vibration which produces a gentle, and not *per se* annoying, humming. This humming in a lamp carelessly constructed or badly managed may become a disturbing noise. According to our experience this noise may be prevented if the lamps are of suitable construction, and are kept in good order.

"Our sittings were held in a room of a wooden laboratory erected by the Board of Works, and lighted by one of the alternating current arc lamps under examination. How very trifling was this humming of the lamp, appears from the fact that, in spite of the great resonance of the wooden sides and ceiling of the room, no annoyance or disturbance was experienced during our deliberations, and that to perceive it general silence had to be observed for a time. Once only the lamp occasioned a disturbing noise, *i. e.*, when a part of the regulating mechanism got loose and acted imperfectly. After the removal of this irregularity the noise subsided again into the ordinary faint humming.

"This property of the alternating lamp does not, in our judgment, present any reason for excluding its use, the more so as arc lamps, whether fed by continuous or alternating currents, sometimes emit a hissing noise; and further, there exists a series of types of continuous current arc lamps which produce loud rattling noises by their regulating machinery.

"As regards the consumption of carbons in the two kinds of lamps the alternating current lamp requires about 20 per cent. more than the continuous lamp. But as the expenditure in carbons amounts only to about 10 per cent. of the total working cost, assuming lamps of the customary strength of 6 to 12 amperes, this larger consumption of carbons does not raise the cost of the alternating arc light by more than 2 per cent., as compared with the continuous arc light.

"The rapid periodic change of the direction and strength of the alternating current involves as many rapid changes of the strength of the alternating arc light. These changes are not perceived in the lamp itself, or in objects at rest or in slow motion. But in objects in rapid movement they appear manifold. Glow lights fed with an alternating current do not produce this peculiarity."

The views of the commission on continuous current transformers, as compared with alternating current transformers, were substantially as follows:

"Continuous current transformers which have found extended use in lighting cities have not come to our knowledge.

"Continuous current transformers in which both coils are arranged on one and the same armature, as it was provided in Schuckert's earlier proposal, and, as it is projected in a more recent offer of Herr Lahmeyer, cannot be recommended on account of uncertainty in working, although they promise a somewhat higher efficiency than the transformers proposed by Schuckert & Co., in which the primary and the secondary coils are arranged on two separate rings. There is no apparent reason for assuming that a continuous current transformer of the latter construction would not hold good as regards safety of action and trustworthiness. To our regret we have had, during our experiments, no opportunity of seeing and testing a transformer of this kind. As no project for Frankfort has been laid before us which seeks to employ continuous current transformers in the same manner as the alternating system proposes to apply the alternating current transformers, a direct comparison of the first cost and the working outlay of the two systems is out of the question. The application of the proposed continuous current transformers is to be combined with an installation of accumulators. Hence the working costs required can neither be separated nor compared at once with the working costs of the alternating current transformers.

"It must further be remarked that the continuous current transformers—unlike the alternating transformers, the operation of which does not involve the movement of masses—necessitates rapidly rotating masses, and has hence to be set up like a dynamo in especially constructed rooms, where it requires continued attention. The new Schuckert plan requires nine such subordinate stations distributed over the city for the installation and management of the transformers. In the alternating current installation, as proposed, there will be 150 groups of alternating transformers to be placed in those quarters of the city to be supplied with electric light, and requiring no attendance of this kind but merely a periodical inspection.

"The degree of efficiency of 82 per cent. claimed by the firm of Schuckert & Co. in their prospectus can, in our opinion, be attained with a normal load of their continuous transformer bordering on the upper limit of its capacity. This degree of efficiency represents a loss of 18 per cent., as against the loss of 5 to 6 per cent. in the alternating current transformer.

"As to the certainty of the work Schuckert's plan contemplates a reserve transformer at each of the nine subordinate stations."

Underground Construction for Electric Wires.[1]

BY NELSON W. PERRY.

Among the objections raised against burying electric wires has been the fact that in many forms of conduits it becomes necessary to introduce the wires in more or less limited lengths and that the points at which these lengths are joined, are points of weakness inherent in the system To this I will say that while joints of this kind do constitute weaknesses to a system, and have been the cause of almost untold trouble in years gone by there are difficulties that can be and have been surmounted by the exercise of proper care and intelligence. It is readily apparent that if the resistance of a joint exceed the average resistance of the line it will cause heating at that point, deteriorating and perhaps ultimate destruction to the surrounding insulation. Since the ordinary solders are much poorer conductors of electricity than the pieces of copper they are intended to unite, it becomes a necessity in order to reduce the resistance at the splice to make the section somewhat larger than that of the line wire. Such a joint is not objectionable electrically in overhead construction, but in the case of conduits where the wires are crowded together in the smallest possible space, this enlargement of the wire at a given point can only be done at the expense of the insulating material between it and its neighboring wires and we have avoided Scylla only to run dangerously near Charybdis.

In the widening of armatures and field magnets for dynamos and motors, splices are unavoidable, and great care is always observed in making them properly.

It is usual in such cases to use pure silver to unite the beveled ends of the two wires, silver being a better conductor of electricity than the copper. The joint may be made no larger than the wires joined, and yet offer less resistance to the passage of the current This presupposes a perfect solder, and involves the expense of the silver, which I think in this country at least, has been but little employed in line construction, either above or below ground.

I dwell upon this so long because in the majority of systems of placing wires underground, the number of splices must necessarily far exceed those required in overhead construction, and because it is probable that it is the strongest point yet raised against the feasibility of burying the wires. I want to show, however, that while the splice has heretofore been a most fruitful source of trouble, it never was necessarily so, was so in fact only because of lack of proper skill and attention in making it, and that now the trouble has been conveniently and cheaply overcome. I refer to the process of electrical welding. By this process absolutely perfect joints, much better in all respects than were possible by soldering, can be made with the utmost certainty in a very few minutes; the sections of such joints need be no greater than that of the pieces joined, their electrical resistance need be no greater and their flexiblity and strength need not differ in any way from that of other sections not welded.

COST OF LAYING WIRES UNDERGROUND.

Where there are but few wires there is no question as to the economy of overhead construction and maintenance. It is true also that the economy of suspension of wires also increases rapidly with the number of wires strung, and within certain limits it may be almost proportional to the number of wires strung. This is particularly the case with light wires, such as telephone and telegraph wires, and least with those carrying large currents at low potential. A point is soon reached with the latter class of wires where the expense of maintenance commences to increase very rapidly with the addition of other wires until it may become so great as to require the erection of other lines of poles. When this state of affairs is reached it will in most cases, be equally cheap to put the wires underground.

As regards maintenance: It has been the experience of those in England and elsewhere, where the greatest success has been met in burying wires, that with proper insulation and sufficient care in placing the wires underground, the expense of maintenance amounts to but a small fraction of that usually to be met in aerial cases, and I think it has been demonstrated that the decreased cost of maintenance after the wires are once laid will in some cases more than counterbalance the difference on the original cost of construction. The citing of instances to the contrary avails nothing in argument in the face of the fact of many actual successes, not only in England where the conduit system is admitted by all to be already an accomplished success, both electrically and commercially, but also in the United States, where we find wires in good working order to-day that were buried years ago. That there have been many failures, is what should be expected when we consider that every one or any one was at liberty to experiment according to his own sweet will. It is a most encouraging fact in this connection that the causes of these failures are, in almost every case, apparent, and while we have in this country had but comparatively little experience in successful conduits, we have had a considerable experience in unsuccessful ones. That we have passed by that experimental stage needs no stronger evidence than the fact that capital is now ready to invest in conduits, depending for a return upon rentals paid by voluntary occupants.

In the case of overhead wires the chief causes of danger to the public arise from the breakage or crossing of wires due to the wind, rain, snow or sleet, or the giving way of the supports. It is apparent that none of these agencies can be effective for danger if the wires be placed underground. I have said nothing about defective insulation in this connection, for the public have no business on the poles, nor have they any inside the conduits. Whatever dangers may be brought to the public that are attributable to faulty insulation, would be the same whether the wires were above or below ground.

The question has been asked, and I am glad it was suggested, "What would be the result in case a buried wire came electrically in contact with the gas or water pipes? Would they not carry danger into every house connected with these systems?" I answer unhesitatingly, "No." The reason is this: That the gas or water pipe before it has reached the house is for its whole length in contact with the earth, thus forming an electrical contact with it that is nearly perfect. It is a law that electrical currents take all paths to which they have access in proportion to their conductivities.

In the case of a gas or water pipe in contact with a live buried wire, the conductivity of the path offered through the earth is almost infinite as compared to any that could be offered by the human body connected, both with the pipe and the earth; there would therefore be no possible danger in such a connection. On the contrary, if the wires were overhead wires, conditions might arise where it would be extremely dangerous for a person to come in contact with any metal such as the gas or water pipes connected with the ground. Overhead wires are so frequently struck by lightning that it is a universal custom to place in all circuits devices for diverting such currents to the earth. These are considered necessary safeguards but are nowhere deemed radical preventives against danger arising from the source. In the case of underground wires the element of danger from this source is practically eliminated. With overhead wires the danger due to the causes first mentioned, very rapidly increase. With the number of wires strung upon the poles, it would be difficult to arrive at a law that would apply in all cases. Still, if the danger increases directly as the number of wires, a limit must soon be reached beyond which it is not safe or proper to go.

If the wires be underground, I have stated that no danger can arise from any of these causes, therefore an increase of their number need not be limited by any such consideration.

There are some dangers from electric wires that will exist whether they be buried or placed on poles, but I do not think of any new ones that are introduced by putting them underground—there are certainly many causes of danger removed by so doing.

It has been stated that telephone wires cannot be placed in conduits on account of the retardation due to the neighboring conductors. This claim has some foundation in fact; it is found that this retardation materially interferes with the long distance service, but does not perceptibly affect the municipal service. Witnesses have stated that while it was possible to put low tension currents below ground, it was not practicable to place high tension currents there. Now, it is only a very few years since 200 volts was considered about the limit of safety in the transmission of currents. A committee of electricians have recently decided upon 500 volts as a safe and uniform pressure to employ in street railway practice; 3,500 volts is now a very common figure to be met with in this country in arc light circuits, and all of these currents may now be found underground, working satisfactorily. It was next claimed that although direct currents of such electromotive forces as these could be successfully buried, the line must be drawn at alternating currents. These latter currents are almost universally of high tension in the primary or distributing mains, and have been supposed to present difficulties not encountered in direct currents of the same potential. In this country the primary circuits of the alternating system usually carry electricity under a pressure of about 1,000 volts, these currents to have been successfully placed underground, and it is believed that the question of practicability of the burial of such circuits is no longer considered a doubtful one by electricians anywhere.

In England they have been much more conservative in electrical matters than we have been in this country, and repressive laws have been passed and enforced to such an extent as to have retarded the wider application of electricity to the arts. It may be said that no step has there been taken in a public way that has not been first duly and thoroughly considered and finally approved by competent authority. If experiments were to be tried they must be in private and not in public, as has too often been the case here. Public property could not be used until the authorities after the fullest investigation became convinced of at least the probability of its success. The result has been that there have been fewer failures and more successes there than here.

Some one has said, "Show me the man who has made no failures and I will show you a man who has made no successes." I believe it is an admitted fact that while we have made by far the most failures in electrical matters we have also made the most successes. Yet, if we are to look for the most uniform success, we must go to the other side of the water where their steps have been uniformly more carefully considered, and where greater attention has been paid to the details than has been customary here.

Now, what do we find to be the practice there? We find not only the direct current high potential circuits buried, but the alternating currents also—and the latter not at the maximum electromotive force of 1,000 volts as in this country, but at an electromotive force of 2,400 volts, (Vide electric light stations at Grosvenor Park and at Nancy) nearly two and a half times as great as we are accustomed to use, and what is pertinent to the question under discussion, these high potential alternating current are buried in conduits and have proved themselves no only a commercial but an electrical success.

But conservative London did not stop here. So marked was the success of distributing electricity by the alternating current at 2,400 volts potential by means of underground

[1] A paper submitted to the Senate committee, Ohio Legislature.

conduits, that the world was startled a year or so ago by the proposition to distribute electricity to the portions of the city of London through a seven-mile main from Deptford by means of the alternating current at a potential of 10,000 volts in the primary wires. Let us see who it was who proposed such an undertaking. Was it to be attempted by inexperienced parties? Was it the outgrowth of ignorance of the question, either financial or electrical? It certainly was not, as it was the undertaking of those having the widest practical experience in the distribution of electricity by means of the alternating current and underground conduits, viz. The same parties who had long ago been making a success of the Grosvenor station. But before a franchise could be granted for such an undertaking, a most thorough investigation under the title of "The Board of Trade inquiry of electric lighting provisional orders" was instituted, before which tribunal such men as Prof. George Forbes, Dr. Alexander Siemens, Sir William Thomson, James Spencer Balfour and Silvanus Thomson testified. A large majority of these and other eminent electricians, although the new project conflicted with the personal interests of some of them, testified as to the feasibility and practicability of the plans. So overwhelming in their favor was the testimony of those examined that Major Merinden brought in a report favoring the proposition, and the franchise was finally granted. It is true that for a considerable distance the mains are not placed underground, it being provided that at street crossings they must be so carried, but the fact is that all of the current generated ultimately does go underground and is finally distributed throughout the district assigned to the company by means of underground conduits.

To show the magnitude of this undertaking, unparalleled in the history of electrical progress, I will quote a few figures. The authorized capital of the company is £1,250,000. Of this there was subscribed April 5, 1889, £500,000, and paid up 1889, £525,000. There had been expended on works at the same date, £430,000. The plant now erecting at Deptford is to have a capacity of 250,000 lights, and it is so planned that with future extensions, its capacity may be increased to 2,000,000 lights. In August last there had been erected twelve 500 horse power Babcock and Wilcox boilers; there were twelve more of equal capacity being installed, and twenty-four additional boilers are contracted for, making 24 000 horse power of boilers for the building now erected. There were at the same time, August, 1889, already erected, two 1,500 horse power engines, each of which drives a dynamo of the DeFerranti type of 1,250 electrical horse power. And there was at that time in process of erection two more alternating current dynamos of 10,000 electrical horse power capacity each.

That an idea of the relative magnitude of this undertaking may be obtained, I will say that so far as I know the largest single electrical generator thus far attempted in this country was constructed by the Brush Electric company of Cleveland, O., for the Cowles Electric Smelting company of Lockport, N. Y., and its capacity was considerably less than 500 electrical horse power. It seems to me that the investment of such large capital on the advice of the best electrical engineering talent in the world, by parties who have already had a wide experience in the distribution of electricity by means of underground conduits, is testimony of the most eloquent kind of the feasibility of such an undertaking. And the fact that the London authorities have passed favorable judgment upon the safety of the underground method upon this hitherto unheard of scale, leaves little to be said upon that score.

The danger from explosions due to collection of gases in subways. This danger is one that has to be met in other cases, and has been successfully met.

When natural gas was first introduced in the streets of Pittsburg, explosions due to accumulation in sewers and cellars were of the most frequent occurrence, but the difficulty has been met and almost completely and entirely overcome. I believe that explosions in electric subways can be entirely avoided by means of ordinary precaution in ventilation. It does not seem to me that this is a difficulty worthy of the name at all, and has arisen chiefly because of ignorance on the part of those constructing the subways in which they have occurred. With our present knowledge and experience it seems to me there can be no possible excuse for trouble from this source in the future.

In the early part of my remarks, I spoke of certain natural limits to the practical extension of the overhead construction of wires. I leave for the last mention of another limit that will perhaps be more apparent than either of the others. It is an electrical law that to preserve the same efficiency or economy of distribution, the weight of the conductors must increase as the square of the current transmitted, if the distances remain the same—they must increase as the square of the distance if the quantity of electricity distributed remains the same, and must vary as the square of the quantity multiplied by the square of the distance. If both are caused to change, and same percentage efficiency is to be maintained, that is to say that, if within a given area it be necessary to supply 10 times as many incandescent lights as before, our conductors must be 10 times 10=100 times as heavy as before. If the same quantity is to be distributed to 10 times the distance, the conductors would have to be 10×10 times or a 100 hundred times as heavy, or if 10 times the current is to be distributed to ten times the distance the conductors must be increased 10 times 10 times 10 times 10=10,000 times to maintain the original efficiency. It is therefore apparent that a practical limit may soon be reached beyond which neither the poles nor the streets can hold the conductors necessary to supply the demands. This limit will soon be reached in centers of dense population, and an outlet for the wires other than by means of the poles is imperatively demanded.

The argument that the time has not yet arrived for the construction of subways, and that if constructed they would only be used by compulsion, is answered so far as Cincinnati is concerned by the fact that the Edison company has within a few days, asked permission to construct subways for its own voluntary use—that upon being refused the permission by the city council, it has gone before the probate court, the last resort, and demanded the right, and has there been given permission; that since that permission has been granted, two other electric light companies doing business in Cincinnati, have voluntarily taken steps to obtain the same privileges.

In reply to your question as to my opinion as to what conditions should be imposed upon such privileges, I will say that I am emphatically opposed to the granting of such privileges to any company to have the exclusive use of any subways. Should subways be constructed it should be only upon the condition that they may be used in common, under proper restriction, by all comers. As to who are the proper parties to construct the subways, whether it should be done by the city, by electric light and power companies, or by corporations existing for the purpose, is a question for the political economist rather than the electrician. But that they should be constructed by some one it seems to me there can be but one opinion.

English Opinions of Safety and Electric Lighting.

The recent discussion in the United States regarding the safety of electric lighting led to the appointment by the senate of the New York legislature of a committee to investigate the general subject of the distribution of electric current for light and power. The report of the committee will be found in the New York letter. It was decided to solicit the opinions of several noted European electricians on the subject. In order that they might treat the same topics a series of ten questions was prepared and they were asked to reply to the queries. The series of questions and the answers of Sir William Thomson and Dr. John Hopkinson are herewith given:

QUESTIONS.

1. Can high tension direct and alternating currents for lighting and power purposes be safely and successfully distributed by means of underground cables? If so, up to what voltage can this be done?

2. If your answer to question 1 is in the affirmative, state whether your opinion is based upon theory or upon knowledge of what has actually been done. If the latter, give a full statement of the facts upon which you base your opinion, showing, as far as possible, the extent to which high tension currents, both direct and alternating, have been distributed by means of underground cables in the various cities of the United Kingdom and the Continent; the length of time during which cables now in successful operation have been in use; the voltage of currents thus distributed in various cities, and the approximate number of lights operated in various cities by means of such cables.

3. Give some idea of the character of the cables used and the manner in which they are laid.

4. What is your opinion as to the safety to the consumer and the public at large, of the converter or transformer system of electric lighting, involving the use of high tension alternating currents in the street mains?

5. What is your opinion as to the relative fire danger in the transformer or converter system and in the low tension direct current system, respectively?

6. In your opinion, is the converter or transformer an effectual safeguard to protect the user of electric illumination from danger, shock or fire?

7. State to what extent the converter or transformer system is now being used in London and other cities in Europe for lighting from central stations, as compared with the low tension direct current system, and in favor of which of the two systems the present development in electric lighting in Europe seems to be?

8. Explain to what extent high tension currents, direct and alternating, are necessary for the successful and economical distribution of electricity for lighting and power purposes, and state what, in your opinion, would be the effect upon the electric light and power industry, and the interests of the public in general, in case the use of high tension direct and alternating currents was abandoned, and all lighting and power work done exclusively by means of the low tension direct current system?

9. Can high tension, direct and alternating currents be safely distributed by means of overhead conductors? If so, under what circumstances, and by means of what precautions?

10. Kindly make any other suggestions which occur to you which will bear upon the present discussion in the United States as to the conditions under which electric lighting from central stations can be most safely, successfully and economically done?

Sir William Thomson sent the following replies:

1. Yes, I believe so, up to 2,500 volts.

2. My opinion is primarily based on general knowledge of the insulating power of the materials used for insulating the conductors of submarine cables and electric light systems, and on measurements made in my own laboratory of voltage required to break down insulations of different kinds. A very small thickness of insulation suffices to resist 2,500 volts, and practically moderate thicknesses are not broken down with 5,000 or 6,000 volts, and are very safe with 2,500, whether direct or alternating. There has not hitherto, so far as I know, been very much practical experience of 2,500 volts on underground conductors in electric lighting, but I have great confidence that it can be carried out, whether with direct or alternating currents, successfully, and with every promise of durability of the materials.

3. A great variety of plans may be used safely and successfully for both direct and alternating currents. One method for alternating currents consists in placing the two conductors as coaxal cylinders, having sufficiently thick space between them filled with insulating material; surrounding the outer conductor with a less thick layer of insulating material, and inclosing the whole in a lead or iron pipe. The conductors for this system may be copper tubes, but it is generally preferable to make them of wire strands laid with a moderate twist on the proper cylindric surfaces. The inner conductor should be of six strands laid spirally as close together as possible, on a hempen or other non-metallic core. Each wire should be prevented from metallic contact with its neighbors by slight insulation. This method gives practically absolute security against danger to the public.

4. With properly laid mains the high tension alternating currents in the street mains underground, involve I believe, no danger whatever, to the public at large. The converter or transformer system can, I believe, be made absolutely safe to the consumers by proper arrangements. It has already been largely practiced in London, Glasgow and elsewhere, and as far as I know no instance has occurred of any consumer having met with an accident.

5. In the event of the escape of gas, in the neighborhood of the high tension mains, the high tension alternating current may set it on fire; but probably not so with the low tension direct current. Within a house or building in which the electric light is used, the danger of fire is not materially different in the two cases, and in either it may be practically annulled by proper arrangements. I believe also, that the transformer itself, when properly constructed, and properly mounted and guarded, does not cause any danger of fire.

6. In my opinion, the transformer, when properly made, properly mounted and supplied with proper safeguards, is thoroughly effective to protect the user of electric illumination from danger from shock or fire.

7. The present development of electric lighting in Europe seems to be in favor of the transformer system on the whole, because of the facilities it gives for transmitting the electric energy over great distances with moderate amounts of copper.

8. The mass of copper required for the economical transmission of electric power to distances of more than a mile is so great, relatively, to the value of the work done, if the potential be limited to 100 or 200 volts, that in my opinion it would be fatal to the electric light and power industry, and to the interest of the public in general to abandon the use of much higher potentials than 200 volts.

9. Yes, I believe perfectly and easily, except in cities; and even in cities by the observance of the rules for public safety which have been imposed by the British Board of Trade. For the transmission to great distances over the country I believe electric energy can be conveyed by currents, whether direct or alternating, through a pair of bare copper wires, at a distance of from five inches to a foot from one another; insulated by porcelain or glass insulators, and supported on poles, with perfect safety to the public. The requisite security against the possibility of electric damage to man or beast, through breakage of a wire or blowing down of poles, can, I believe, be made practically perfect by proper appliances.

10. The comparatively small currents required in the mains on the high tension alternate current system give it many advantages over all low tension systems; as, for instance, the smallness of the conductors and consequent ease of laying as well as economy of prime cost; and the security against any current strong enough to do damage underground or elsewhere being allowed at any time to pass through them, through any accidental short-circuiting at crossings.

Dr. Hopkinson's replies to the questions were as follows:

1. It has been conclusively proved that alternating high tension currents can be supplied without inconvenience by means of underground conductors if the work is properly done; it has also been proved that this can be done with a potential of 2,400 volts. So far as I know it has not yet been proved that a potential of 5,000 volts can be safely used. This potential, however, is now under experiment.

2. A Silvertown cable in an iron pipe has been in existence under a potential of 2,400 volts, underground in St. James' Park for about two years.

3. I have already indicated the character of the cables used.

4. There is in my opinion no reason whatever why high tension alternating currents should not be used in the street mains.

5. In my opinion there is practically no difference as regards fire risk between the converter system and the direct current system.

6. In my opinion a properly constructed converter with a suitable cut-out is an effectual safeguard to the consumer against danger from shock. As regards fire the precautions must be the same as with the direct current system.

7. In addition to the alternating current system stations there are in this country certain direct current installations. In London there are the St. James' company, the Chelsea company and the Kensington Court company. In the provinces there is Bradford and there are other places. So far as I am able to judge there seems to be a somewhat larger application of alternating current than of the direct in London. Taking the whole of the country it is difficult to say; it is proposed to apply each in many places.

8. The great advantage of the high tension system is that the generating station may be placed at a considerable distance from the work to be done. In cases where the generating machinery can be put close to the work no doubt the direct system would be adopted. But in large towns this is not infrequently impossible, not alone upon the ground of capital outlay in real estate, but also on the

ground that the powerful machinery required would be an annoyance in the neighborhood. Thus, if high tension currents were prohibited it would involve two things for the public, a much greater cost of supply and the annoyance of machinery placed in a place where it is undesirable.

9. The experience of the Grosvenor Gallery company shows that high tension alternating currents can be safely distributed by means of overhead conductors; this has been attained by the use of thoroughly well insulated conductors carried upon independent bearing wires.

10. In my own practice I am guided in the choice of high or low tension entirely by the consideration of where the generating plant is to be placed. If it can be conveniently placed in the immediate neighborhood of the whole work to be done, I adopt the direct system of supply at low tension; if this is not the case, however, I advise the adoption of high tension alternating currents.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 29, 1890.—The senate committee on general laws has made its report to the legislature on the result of the investigation conducted under its supervision with the object of securing information that would enable the legislature to regulate the electrical business of this state. The report states that the committee soon found itself at sea and was obliged to secure the services of an electrical expert to assist it in its examinations. Among the witnesses examined were the following: Edward H. Johnson, late president of the Edison Electric Light company, and Mr. Bowker, first vice-president of the Edison Illuminating company; Geo. W. Hebard, president of the United States Lighting company; C. H. Jackson, president of the United States Illuminating company; Wm. H. Browne, manager of the United States Light & Power company, Jacob Hess, commissioner, and Daniel L. Gibbens, late commissioner of the Board of Electrical Control of the city of New York; Henry D. Kearney, engineer, and Schuyler D. Wheeler, electrical expert of that board; Edward Martin, inspector of the New York Health department; two representatives of the New York Board of Fire Underwriters, Coroners Schultze and Levy, Thomas Costigan, chief clerk of the district attorney's office; Prof. Plympton, professor of physics in the Polytechnic institute and president of the Board of Electrical commissioners; Dr. Henry Morton, president of Stevens Institute of Technology, Hoboken, N. J.; Dr. George H. Benjamin, electrical expert, and William Maver, Jr., electrician of the Consolidated Telegraph & Electrical Subway company of New York. The committee found that sixteen persons had been killed in New York City during the last three years, that most of the victims were employes of electric lighting companies, and that the accidents were due to carelessness. "It appears doubtful," says the report, "if an overhead system of wires carrying high tension currents could be under any circumstances maintained in the crowded streets of New York without more or less danger to the public." It advises the immediate burial of all electric light and power conductors not only in the metropolis, but also in all cities of the state having 125,000 inhabitants and over. The committee did not rest with local experts, but sent to the best European electrical engineers for their opinions. Sir William Thomson, Prof. George Forbes, Dr. John Hopkinson and William H. Preece made depositions regarding the operation of electrical companies on the other side. In view of all the testimony presented the committee expresses the conviction that both the high and low tension systems can be made equally safe to life and property by the use of proper safety devices The opinion of the committee may be summarized in the following statement taken from its report: "Considering the testimony taken, we do not think it possible for the legislature to form satisfactory rules and regulations for application to an industry which is not only highly technical, but constantly developing and presenting new conditions, rendering the rules proper this year, possibly obsolete next year. There should, however, be some form of supervision by properly qualified state or local authorities over the commercial use of electricity analogous to the supervision now exercised over steam boilers. Regulations should be framed with competent expert advice and intrusted to authorities who have power to modify them, so as to meet the changing conditions which the rapid growth of the industry constantly brings about." The suggestion that no wire carrying over 250 volts be allowed to enter a building, is also offered. In this connection it might be well to call attention to the unbiased statements of English experts who were consulted by the committee, and on whose testimony so much stress was placed. One of these, Prof. George Forbes, wrote: "If panic legislation were to stop the use of high pressure currents of electricity the public would be largely deprived of a great boon." In relation to the action of the local authorities, the same gentleman said that had they not lost their heads and had they been fitted for the work in hand they would have been able to avert the calamity that visited this city. After comparing the methods pursued in New York and London, William H. Preece, superintendent of the postal telegraphs of England, says there have been but two deaths due to electric current in five years in England, "and it is by no means evident that even these were due to the high tension system."

Commissioner Gilroy has about given up hope of having the Subway company complete its work in time to have him proceed with the work of paving the streets of the city. He said at the meeting of the Board of Electrical Control Wednesday, that he would wait no longer, and that he would refuse the companies permits to tear up streets after they had once been paved. Mayor Grant is again getting huffy over the dilly-dallying of the companies and unless an agreement is soon reached another outbreak may be expected.

The New York Electrical society upon the invitation of the Westinghouse company, was treated to a inspection of the plant at the Equitable building Wednesday evening. Advantage was taken of the invitation by a large number of the members of the society and their friends. The whole of the plant was in operation and an abundant opportunity was afforded of making the practical acquaintance of every detail of the system.

Oliver J. Geer and D. Fahnestock, as mortgage trustees, have brought suit in the Supreme Court against the Electric Accumulator company to have a receiver appointed, and to restrain stockholders from interfering with the company's property. Several years ago the company executed a mortgage for $1,000,000 upon its New York and New Jersey property and its patents to secure first mortgage bonds, which have been issued to the amount of $957,400. Default has been made in the redemption of the interest coupons of June and December, 1889. Mr. Treux said that the trustees were conducting the business of the company until a reorganization could be effected, which is likely to be completed in thirty days, and that the affairs would be in proper shape.

Walter P. Phillips, manager of the United Press association, has taken a lively interest in the arrangements for the fast telegraphing tournament, and in a recent letter to Manager Catlin contributes $100, in four prizes of $25 each, one for each class. The conditions of the proposition are that the prizes shall be awarded to the contestants who shall be adjudged to have done the most finished and accurate sending in the quickest time.

The latest development in the subway matter was in the nature of a surprise to all concerned. The Supreme court to-day granted George E. Armstrong an injunction restraining the Standard Electrical Subway company from acting under the provisions of its contract with the Board of Electrical Control, thus overruling Judge Andrews' decision. In his opinion, Presiding Justice Van Brunt says: "The immediate object of the board was that the subways should be made to include the streets and avenues mentioned in the resolution, and to be completed within the current year." But the accomplishment of this object is not secured by the terms of the present contract, as there is no provision which binds the company to build such conduits as the board may direct, nor is there any specification concerning the time in which the work is to be completed. Moreover, by inserting a clause making the members of the board the persons to whom all disputes shall be referred for final adjustment, the contract was made to conflict with the act of 1887, which invested the justices of the supreme and superior courts, and court of common pleas, with power to hear and determine all disputes as to the use of the subways. The contract did not provide for the purchase of the subways by the commissioners of the sinking fund, as required by the same act as last referred to. Other defects are also pointed out and the court refers to these objectionable features as follows: "It is true that some of these defects are not so fundamental as to justify, if they stood alone, the prohibition of the court that this contract should not be entered into. But there are others of so radical a nature as to involve an entire want of authority in the action authorized to be taken by the board. These attributes consist mainly of the omission to bind the Standard company to the construction of the subways mentioned in the resolution and to do that within the period of one year, which in the judgment of the board, would be sufficient for that purpose." In conclusion, the court says: "Experience has demonstrated the necessity of requiring corporations in their contracts with municipal bodies or their officers to clearly and explicitly define their obligations, and leave as little as possible to future uncertainties, for after the agreements or privileges may be obtained the exacting disposition of the parties contracting with these bodies is such as to exclude all possible concessions or understanding which may be essential to promote and protect the interests of the public. These contracts cannot be made in language too plain or concise to prevent the possibility of future disputes and controversies. And while the granting of an injunction against the execution of a contract such as the one proposed will be attended with some delay in securing the accomplishment of the object intended to be produced by the action of the board, it will in the end be much more advantageous to the public that its interests shall be clearly and expressly limited here than to permit the contract now proposed to be entered into to be executed, which could not fail to engender disputes, and would leave it to the volition of the Standard company to construct subways or not as it might afterward determine to be most expedient for its own interests." W. H. T.

Louisville, Ky.

LOUISVILLE, Ky., March 31.—The telegraph, telephone, fire alarm and electric street railway wires suffered more in proportion than any other business by Thursday night's tornado, which devastated such a large section of this city. Friday morning there was but one system of telegraph wires running out of the city. They were in the Panhandle depot, north of the path of the tornado, and gave communication with Indianapolis. The Ohio Valley Telephone company had few lines fit for service, and the municipal fire alarm system was seriously crippled. The Green street electric railway was suspended the rest of the week.

Capt. H. N. Gifford, general manager of the Ohio Valley Telephone company, says the loss to his company will be $20,000, and the Western Union did not lose so much. The tornado swept across the northwestern portion of the city, and did not quite reach the center of the city. Not a wire in its path but those underground escaped destruction Telegraph communication with the entire eastern part of the city was cut off. The strong poles which supported the wires were wrenched off close to the ground, and the wires entangled among the debris. The old material is not worth the gathering. Not a single railroad had an open wire out of the city Friday morning except the Pan Handle, and Manager Smith of the Western Union early in the morning started his men across the river to Jeffersonville with their pockets filled with dispatches. The broken lines which came from the North to Louisville were hooked to instruments in Jeffersonville, and a half dozen wires were kept going the rest of the day and Cincinnati and Indianapolis were soon flooded with news for the East. The personal dispatches were filed by the hundreds, and special newspaper correspondents sent dispatches of 10,000 and 15,000 words each to Chicago, New York and Boston dailies. The Western Union men worked nobly and finally caught even with their work Sunday morning at 3 o'clock.

Not till last night were telegraphic reports received from the damaged districts of Western Kentucky. Dispatches were immediately sent to all the adjoining states for experienced linemen, who restored many lines Saturday. On that day 5,000 messages were received and 4,000 sent out by the Western Union men. They were all short, inquiring for and giving information about friends and relatives. The bulk of the work was specials for newspapers. The services of seventy-five messenger boys were required and some made as high as $8 apiece for the day.

The damage to the fire-alarm system made the loss by fire greater than it otherwise would have been. Fire Chief Hughes notified the public to send alarms of fire to the nearest engine house or telephone them to headquarters if possible.

One-third of the telephone service was destroyed. Manager Gifford immediately dispatched to Cincinnati and Chicago for experienced workmen. Vice-President and General Manager Stone of the Cincinnati company sent all the men he had at hand.

It will require several weeks' work with extra forces to restore all the telegraph, telephone and fire-alarm lines in Louisville. B. A.

Kansas City, Mo.

KANSAS CITY, Mo., March 29.—The Kansas City & Suburban railway stockholders will, on May 31, vote upon the proposition to issue first mortgage bonds to the amount of $100,000, for the purpose of constructing the electric line this summer on Troost avenue, from the termination of the cable line on that avenue to Waldo park and to Forest Hill cemetery. The line will also connect with the Holmes' street cable line at Springfield avenue by going west on Fussell avenue to Holmes and north on Holmes to Springfield. At Waldo station passengers on the Kansas City & Southern road will be transferred to the electric line, and thence to the cable lines and to the Union depot.

Another suburban line that will connect with a cable line in this city is the Kansas City & Blue Valley Railway company's road, which will extend, when completed, from the end of the Fifteenth street cable to Manchester, Centropo-

lis, Sheffield, and other parts in the Blue Valley portion of the city. On April 12 the stockholders will be called upon to vote upon the proposition to increase the capital stock of the company from $25,000 to $75,000, and to vote bonds for the total amount, which will undoubtedly be done, and will immediately be followed by the beginning of construction.

The Metropolitan Street Railway company will improve the service on the Armourdale electric line by putting another 15-horse power motor upon each of the 10 motor cars now in use and then attach extra coaches whenever necessary. Ten summer cars have already been ordered and will soon be delivered.

The North East railway is proving a success in every particular. It is paying from the start. All the horse cars have been taken off that part of the line which was formerly the Independence avenue horse car line, a branch of the Metropolitan railway system. In a few days the full equipment of the electric line, ten cars, will be running. Six are already on the road. The new track and the new cars necessarily make riding a little rough at first, but this is rapidly wearing away.

Charles W. Hastings, now connected with the Missouri & Kansas Telephone company, claims to have thought out four years ago the principle of Edison's recent scheme of using instantaneous photography in connection with the phonograph. Mr. Hastings called his machine the "Photo-Phono-Trope." He made his idea public, being then a reporter, by writing up an imaginary interview with an inventive drummer from a good old Yankee state. This article was published in the Kansas City *Journal*, Feb. 12, 1886.

An application of the phonograph has been made by Patrick Regan to the cash register. When the key of the register is pressed down, not only will the machine register the amount, show a card giving the amount, but cry out the sum of the customer's purchase. Arrangements are under way for the organization of a company here to manufacture and sell the phonographic register as soon as it has become patented. P.

Dayton, Ohio.

DAYTON, O., March 29.—Electrical traction in this city has assumed quite an important feature in the opening of the two electric roads to the Soldiers' Home, a distance of three miles from center of the city. The White Line Street Railway company started some three weeks ago to run half hour cars from its northern termious to the Home, a distance of five miles for a through fare of 5 cents. On Sunday afternoon the cars are run every 15 minutes and are crowded to their utmost capacity. The Dayton & Soldiers' Home electric road, which runs from the western city limits to the Home, about a mile and a half in length, will start its cars in a few days. They will operate in connection with the Fifth street horse car line. D.

Boston, Mass.

BOSTON, Mass., March 28.—The annual meeting of the American Bell Telephone company was held in this city this week. The report for the year 1889 was made public and is of great interest, not only because of the splendid financial showing the company is able to make; but because of the mass of statistical information it contains. The total earnings of the year were $4,044,704 71; the total expenses, $1,385,966.02; leaving as net earnings the handsome sum of $2,658,739, out of which stockholders have received dividends amounting to 18 per cent. of the capital stock. The total net earnings for 1889 were equal to 20.7 per cent. of the capital stock. Legal expenses have decreased from $222,257 in 1888 to $144,567 in 1889. The company's telephones are valued at $827,212. The patent account is credited with $10,432,362. At the end of the year 1889 the company had 757 exchanges, 471 branch offices, 154,009 miles of wire on poles, 11,484 miles on buildings, 27,117 miles underground, 603 miles under water, or a total of 193,213; 6,758 employes, 185,003 subscribers, and 444,861 instruments in the hands of licensees. The number of connections made daily in the United States is estimated at 1,240,147, or more than 400,000,000 in a year. The average number of calls per day per subscriber, is 6.7, varying, it is said, from 2 to 15 in different exchanges, while the average cost per call varies from 2 to 13 cents. Fifteen new exchanges were opened during the year, and 33,350 additional instruments put into use. At the end of the year the number of extra territorial lines was 969, with 35,254 miles of pole lines and 86,728 miles of wire. The average number of connections made on these lines per day was 8,289, or a total of nearly 3,000,000 for the year. January 1, 1890, the long distance lines included 1,918 miles of pole line and 34 799 miles of wire on poles and 805 miles of wire in cables. All of these figures show a marked increase in the company's business over that of the preceding year, the net earnings applicable to dividends having, in fact, increased 9 per cent. The earnings in 1887 were $20.80 per share; in 1888, $24.25 as against that now reported for 1889, $26.72 per share, while the capital stock on which dividends were earned has been largely increased. The number of shares at present is 113,030, which will be increased April 19 to 125 000. The company expects to take possession of its new switchboard in the new building at the corner of Milk and Oliver streets, about May 1.

Col. E. H. Hewins, general manager of the Union Electric Car company, read a paper on "The Application of Storage Batteries to Street Car Propulsion," before the Society of Arts last evening. In describing a "recharging device" invented by W. L. Stevens, by means of which the car motor may be utilized as a dynamo to recharge the cells or act as a brake whenever the car was going down hill, he said that the amount of power so returned to the batteries on the Beverly and Danvers street railway, operated by the Union Electric Car company, was by careful measurement ascertained to be about 14 per cent. of that taken out, while the increased mileage resulting therefrom with the same amount of power supplied was about 9 or 10 per cent. Col. Hewins exhibited gears which had done service over 8,000 miles on a street railway car. Stereopticon views were shown of the details of the system. He said that on the Beverly and Danvers road the batteries were recharged after the car had run 30 miles.

The Board of Aldermen has passed an order limiting the speed of the electric cars to 7 and 12 miles per hour in the crowded and suburban streets respectively.

Edward H Johnson, in company with Messrs. Greenfield and Underwood, gave an exhibition test of the working of the interior electrical conduits at the Tremont theater in this city on Wednesday of this week.

The New England Telephone and Telegraph company has declared a dividend of 75 cents per share, payable on May 15 to stockholders of April 2, 1890.

In his lecture on "The Electrical Transmission of Power" before the Harvard Electric club, last Monday night, Capt. Eugene Griffin said that the Thomson Houston Electric company was now turning out 50 street car motors per week, and that it had 1,100 motors on its unfilled order list.

The Cornell University students, who were in this city three days last week, left on Monday morning at 8:30 for Providence. O. H. M.

BOSTON, Mass., March 26.—A large party of Cornell university professors and students of the electrical engineering department, traveling upon their annual inspection tour, arrived in Boston Friday morning, and put up at the United States hotel. The party numbers nearly 30, and includes Professors Nichols, Morris, Moler, Snow and Merritt, and resident graduates Humphrey, Marks and others. Friday was spent in an inspection of the West End electric railway system and power plants, and a visit to the physical and engineering departments of the Massachusetts Institute of Technology. The evening was spent at the Congress street station of the Boston Electric Light company. On Saturday morning the entire party boarded the train on the Boston & Maine road and were soon inside the great factories of the Thomson-Houston company at Lynn. After several hours spent in examining the construction of the Thomson-Houston electrical machinery a visit was made to the shops of the Thomson Welding company. An hour was spent on Saturday evening at the fine station of the Edison Electric Illuminating company. The party will remain in Boston over Sunday and will leave for Providence on Monday morning, stops being made at several other places of interest on the route to New York. Both students and professors are enthusiastic in their work, and are enjoying their trip immensely.

A party of 32, representing the city government and the street railways of Worcester, Mass., paid a visit to Lynn one day this week and made a thorough examination of the working of the electric system of the Lynn and Boston street railroad.

The "Willows" branch of the Naumkeag street railway system at Salem, Mass., is again to be run by electricity. This is a summer road leading from Salem to a seaside resort two miles out of town. Two years ago it was equipped and operated for one season by the Sprague system. That electricity is to be resumed shows that the management has abundant confidence in that means of motive power.

The report that the West End street railway company is to be indicted for causing the death of Mr Bradford, who was killed recently by an electric car, is denied by the company's officials.

On next Monday evening the Boston Electric club will be entertained by a paper by W. J. Denver, of the New England Telephone company upon "Induction and Interference with Telephone Service, from a Telephonic View."

The Lynn Daily *Press* of Wednesday, March 19, contains a large cut reproduced from a photograph of Professor Elihu Thomson. The cut is accompanied by a biographical sketch of the professor.

At a recent dinner of the Massachusetts Boot and Shoe club, Fire Commissioner John R. Murphy, in an after dinner speech, said: "Electricity is very important in all fire matters. The question of getting an engine of the greatest water throwing capacity with the greatest celerity to a fire, will, it seems to me, be solved by electricity. Substitute for the steam power of any modern engine stored electricity or electric power conveyed to each hydrant, making of your engines a pump on wheels, and you have lightness itself as regards weight, with almost unlimited power of throwing water. This will be the fire engine of the future; so the prophets say." O. H. M.

THE ELECTRIC LIGHT.

The new plant at Alamosa, Col., is now ready for operation.

A new electric light company has been organized at Montgomery, Ala.

The construction of an electric light plant at Washington, Ga., is contemplated.

Vernon (Tex.) will have a $60,000 electric light plant erected by a stock company.

The Pittsburg Development company will erect an electric light plant at Carnegie City, Va.

Newport (Ark.) will have an incandescent plant of 650 lights' capacity and a 50 light arc dynamo.

B. F. Draper of Ligonier, Ind., will add a Thomson-Houston 20 light arc machine to his plant.

Glasgow, Ky. is considering a proposition by Cincinnati, O., capitalists to erect an electric light plant.

Stanford, Ky., has issued bonds for $20,000 to secure funds for the erection of a city electric light plant.

The Vernon Electric Light Power company at Tallapoosa, Ga., will enlarge its plant at an early day.

Owenton, Ky. will have an electric light plant. A company composed of local capitalists will erect the plant.

Swanton & Clark of Santa Cruz, Cal., have purchased a Thomson-Houston 650 light alternating current dynamo.

The Queen City Electric company, of Cincinnati, O., will increase its capital stock from $50,000 to $200,000.

A 20 years' franchise has been awarded L. Hirsch at Newport, Ark., to operate an electric light and power plant.

The Citizens' Electric Light company started up its machines in East St. Louis last week. It has 60 lamps on the streets.

The capacity of the Badger Electric company at Racine, Wis., has been increased by a Thomson-Houston 30 light arc machine.

The Opelika, Ala., Electric Light & Power company will erect a power house at once and install an arc and incandescent plant.

The Central Electric company of Lexington, Ky., has awarded a contract for an incandescent plant to be installed at once.

The Shreveport, Gas & Electric company, Shreveport, La., will install a 50 light arc machine of the Thomson-Houston system.

A Thomson-Houston 30 light arc dynamo has been added to the capacity of the Mt. Clemens Electric company, Mt. Clemens, Mich.

An electric light plant will be installed at Stuttgart, Ark., by the local Improvement company, recently organized, with $150,000 capital stock.

The Brush Electric Light & Power company at Savannah, Ga., has awarded a contract to the Westinghouse company for a 750 light dynamo.

An electric light company has been formed in Bridgeport, O., to build an electric light plant that will cost about $10,000. Its bid to furnish the town with 25 arc lights was accepted by council.

The Van Buren (Ark.) Investment company has been incorporated, with a capital stock of $50,000, to construct and operate electric light, gas and waterworks. W. H. Shibley, G. R. Wood and W. H. Ross are interested.

The Westinghouse Electric company has been awarded the contract of furnishing alternating current apparatus to increase the capacity of the lighting plant of the Nashville Lighting & Power company to the extent of 3,000 incandescent lights. Twenty-eight hundred lights' capacity of Westinghouse apparatus is already in use by this company. In addition to the order for incandescent machinery, the Nashville company has placed with the Westinghouse Electric company one for 540 arc lights.

The Citizens' Electric Light & Power company, of Lansdowne and Clifton, Pa., has been organized, with a capital stock of $25,000. President, James S. Austin; vice-president, S. L. Kent; secretary, W. J. Crawford; treasurer, Charles L. Bartleson; directors, James S. Austin, John M. Shingley, James Garrett, Edward V. Kane, Dr. J. M. Phillips, S. L. Kent, John Adams and Thomas Burwell. The company will begin work at once, and expects to be in

operation at both Clifton and Lansdowne within four months.

The Fort Worth (Tex.) Electric Light & Power company has let contracts to the Westinghouse Electric company, of Pittsburg, Pa., for additional machinery.

The Thomson-Houston company of Atlanta, Ga., has found it necessary to increase the capacity of its plant and has placed an order for machines for 1,000 incandescent lights.

The Opelika (Ala.) Electric Light & Power company recently organized, has adopted the alternating system, and awards the contract for its plant to the Westinghouse company.

The rapid development of electric lighting in Omaha, Neb., and the application of electricity in other forms has caused the city council to establish the office of city electrician.

The Grafton (W. Va.) Electric Light, Heating & Power company has been incorporated with an authorized capital stock of $100,000, to erect an electric light plant. It has franchise to light the town.

Saginaw, Mich., according to the annual address of the mayor of the city, has 131 arc lamps illuminating its streets. The service has been greatly improved and additional machinery is being introduced.

The Warrensburg, Mo. Electric company has been incorporated with a capital stock of $25,000, to generate and sell electricity for light, heat and power; incorporators—James H. Christopher, James D. Eads, Geo. B. Shaw.

The electric light plant at Huntingdon, Pa., was successfully put in operation last week. The system used is the Thomson-Houston, and the officers are: President, J. Simpson Africa; secretary, treasurer and superintendent, B. F. Africa.

The annual visitors to Bluff Point, N. Y., may prepare themselves for a surprise this summer, because this fashionable resort will have a central station alternating current electric light plant. The Westinghouse Electric company, of Pittsburg, Pa., was awarded the contract for furnishing the machinery of the plant, which is to have a capacity of 1,500 lights.

The lunatic asylum at Mimico, near Toronto, Canada, is illuminated by the incandescent light. When the plant was started, so astonished were the inmates that one poor fellow bowed down and kissed the floor. Six large boilers for lighting, heating and laundry purposes, were installed by Purdy & Co., of Toronto. An Armington & Sims engine, of 35-horse power, making 300 revolutions per minute, is used. The plant was installed by the Ball Electric Light company, of Toronto. The lamps are 16 and 32 candle power.

At a meeting of councils in Allegheny City, Pa., March 7, Superintendent Hunter reported that the work on the new electric plant is progressing rapidly. The lower portions of the foundations are all completed; 600 poles have been set, all city buildings have been wired, and it is expected that the power house will be completed by April 1, and the plant will be ready for operation May 1. This plant is to be operated by the city. It will have a capacity of 3,000 lights, and will be furnished with the Westinghouse alternating current system.

A gas journal prints the following complimentary notice of an electric light plant: "One of the best arranged and most capably managed electric light plants within the borders of the state of Georgia is that owned by the Athens Gas & Electric Light company; and it ought to be a good one, for $50,000 were expended in its construction and equipment. It might also be said that the gas works are modern and complete. The electric annex contains two steel boilers of 70-horse power each, and two engines (one of 70-horse and one of 50-horse) which operate one 50 light arc machine, and one 650 light incandescent dynamo. The apparatus was furnished by the Thomson-Houston company, and it is handsome and complete. Forty arcs are now in circuit, and the company has application for 300 incandescent lamps, which it is now arranging to supply. Dr. J. A. Hunnicut, president of the company, has great faith in its future."

A Cleveland paper says: "The ordinance granting the Citizens' Gas & Electric company, the right to lay mains and pipes in the streets will be bitterly opposed by the old gas companies. President Morley, of the Cleveland Gas Light & Coke company, called on the mayor Wednesday morning, and expressed his disapproval of granting the new company a franchise. Mr. Morley claimed that the organization of new gas companies never benefited the citizens of any city. Sooner or later they were either purchased by or consolidated with older competitors, and nothing was gained for the public in the way of cheaper or better gas. Mayor Gardner, after Mr. Morley had retired, expressed the opinion that the fight which had been waged every time a new gas company was proposed would be renewed. The incorporators of the company now asking for privileges were good men, the mayor thought, and he was inclined to believe that they meant business. One of the promotors was at the mayor's house earlier in the morning than Mr. Morley, explaining their plans to his honor. The Citizens' company propose to light with both gas and electricity."

An example of western enterprise is presented at Fairhaven, Wash., a "city" of six months. In January last an electric light and power company was organized with a capital of $100,000. An incandescent plant of 500 lights' capacity, and an arc machine for 55 lights were installed. When the company got its machinery ready for operation it was found that the demands for light and power service greatly exceeded the capacity of the plant, and it was accordingly decided to enlarge the station and install additional machinery. Plans have been adopted and within a short time it is hoped the new power plant will be ready. Edison dynamos of 2,500 lights' capacity have been ordered and American arc machines, capable of operating 155 lamps, will be installed. Besides lighting the city the company will furnish power for manufacturing and other purposes. Motors of all sizes will be furnished from that of one-tenth horse power to one large enough to run any ordinary manufacturing business. The smaller motors can be used in private residences for running a sewing machine and many of them will be in use in a short time. The presses of the Fairhaven *Herald* will be operated by one of the larger motors.

THE ELECTRIC MOTOR.

The Fort Worth (Tex.) & Arlington Heights Street Railway company has, it is reported, commenced the erection of its electric power house.

The Burlington, Ia., street railway lines will be transformed into an electric system. The council has granted permission to make the change and the contract has been awarded.

The Thomson-Houston Electric Light company of Memphis, Tenn., has, it is reported, increased its capital stock $100,000, and will erect a power house to furnish power to the street railways.

The Grove street electric road at Oakland, Cal., will be completed within a year. Work is already under way, and it is hoped that the line to the city limits will be finished within three months.

An exchange says: Boston street cars are so pleasant, speedy and convenient since the introduction of electricity as a motor on the railways of that city, that they are becoming the fashionable vehicles for opera patrons.

The stockholders of the Seattle Wash. Electric Railway company have elected the following trustees to serve during the ensuing year: L. H. Griffith, Angus Mackintosh, D. T. Denny, Dr. E. C. Kilbourne, V. Hugo Smith, Andrew Abbott.

The first pole upon which will be placed the wires for Sedalia's electric railway system was planted March 19, a thousand or more people being present to witness the ceremony. Addresses were made by Mayor Crawford, G. W. Barnett, Henry Lamm, W. S. Shirk and Judge D. C. Metsker, of Topeka, Kan., the president and superintendent of the Sedalia, Mo., Electric Railway, Light & Power company, which is building the road.

Experimental trials have been made on the Southwark subway in London, with the electric locomotive, by which the trains on this new underground line are to be worked, and highly satisfactory results have been obtained. With a train of three carriages, carrying 100 persons, the maximum load to be carried by any train when the line is open for traffic, a speed of twenty miles an hour was obtained, and the locomotive alone ran at the rate of thirty miles an hour.

The Transcontinental Street Railway company, which has the most extensive system of street railways in Portland, Ore., has decided to supplant horse power by electricity, and will adopt the overhead wire system. Objection has been made by property owners to the erection of poles and the stringing of wires in the streets of Portland by the electric companies now established, and it is feared opposition will be developed against the Transcontinental company.

The Laredo, Tex., Electric Motor Street Car line commenced running to the bridge across the river March 12, and that city can now boast of having the only international electric motive power connection in the world. The large steam plant, consisting of boilers and engines, to be used in connection with the electric motor street car power house to furnish the additional power required for 2,000 incandescent and 200 arc lights, will be put in position at once. This gives Laredo two of the largest electric light plants in the state, and insures an abundance of light.

Contracts have been awarded at St. Louis for most of the work on the Liadell Railway extension, and it is expected that the entire line will be completed within the next three months. The total cost of the extension will be about $1,200 000. The power house building alone will cost $150,000, and will contain four engines, having a capacity of 1,600 horse power. One hundred motor cars and 250 coaches will be used along the line. The first work on the extension will be from Manchester road to Forest Park. In Forest Park a pavilion will be erected at a cost of $25,000.

One of the most important franchises recently granted in Kansas City, Kan., was that to the Enright-Thayer company to build and equip seven miles of double track electric railway. The overhead system will be adopted. Ten motor cars will be operated with trailers. The road will cost $300,000. This line will extend through Argentine, Armourdale, Kansas City, Kan., to Kansas City, Mo., crossing a long viaduct. The right of way has been secured and everything is now in readiness excepting the franchise for two miles in Kansas City, Mo., but no trouble is anticipated at this point.

The managers of the Federal Street & Pleasant Valley street railway of Pittsburg, Pa., which has been operating 25 motor cars on the Sprague electric system for some time, are so well pleased with the operation of the cars on that road that they have ordered an additional equipment of 14 motor cars. Each of these cars will be equipped with two Sprague improved railway motors. The grades surmounted by the electric cars upon this road are quite severe, being in one place about 12½ per cent., the length of the grade being over a mile. With the old original equipment this grade was considered too steep to be ascended in the ordinary manner, and at the steepest part a rack was used between the tracks in which a pinion connected with the motors engaged, in order to secure the necessary traction. With the new equipment this arrangement is found to be unnecessary, and the Sprague cars have no difficulty in ascending the grade with the aid of no other traction than that which the wheels secure from the rails themselves. There are now over 30 cars in regular operation upon this line.

The Rae system of electric railways is in operation in Fort Worth, Tex., and a local paper makes the following flattering allusion to the operation of the line: "The Houston street electric car system has been universally voted a grand success by the public, but with the new improvements in the way of trucks, etc., etc., which were added to-day, it is absolutely perfect. The cars now run smoother and faster than before, and there is nothing to mar or jar the progress of these chariots of the people. There is not in the United States a more perfect system of electric locomotion than that now adopted by the Fort Worth Land and Street Railway company, and the city is to be congratulated on its public spirit and enterprise." The same system of electric propulsion is in operation in Saginaw, Mich., where it is equally satisfactory. The mayor of the latter city, in his annual address, made the following reference to the Rae system in that city: "I believe we did a wise act when we granted the street railway company the right to change their system into the electric power. Rapid transit is demanded by the public, and in giving the right to the company to change their motive power from horses to electricity, we enabled the company to give better communication to all parts of our city. I believe that our city to-day as far as street car service is concerned is second to none. I believe that we stand head and shoulders above all our neighbors."

THE TELEGRAPH.

Two telegraph operators have been arrested in New York City for "tapping" pool room lines over which returns from races were received. They will be prosecuted by the Western Union Telegraph company.

The Laredo (Tex.) Improvement company is authority for the statement that the business of the Western Union Telegraph company at that point last year showed an increase of 97 per cent. over the previous year.

The Inter-Ocean Telegraph company has been incorporated at Alexandria, Va., with D. H. Bates, of New York city, president, and J. F. Hood, of Washington, D. C., secretary, to construct and operate telegraph and telephone lines. The capital stock is $100,000.

The Western Union Telegraph company has purchased the plant and franchise of the Sandy Hook, Quarantine and City Island Telegraph company which was organized by several of the members of the Maritime Exchange for the purpose of getting information at New York concerning incoming vessels, but it has been operated by the Western Union.

Miscellaneous Notes.

George Cutter of Chicago, has gone to Boston on a two weeks' business trip,

The American Electric Supply company has been incorporated at Chicago, to manufacture all kinds of electric apparatus; capital stock, $250,000; incorporators, F. E. Shaw, William Martin, W. O. Johnson.

The Ohio Gas Light association, which convened for its sixth annual meeting at Toledo, March 19, considered a number of questions of interest to electric light men as well as gas companies. Among the papers prepared for the occasion were these: "Municipal Control of Lighting," H. Wilkiemeyer, superintendent Gas Light & Coke company, Portsmouth, O.; "Combination of Gas and Electric Lighting in a Small Town," George W. Bowers, secretary Gas & Electric Light company, Hillsboro, O. Among the subjects presented for special consideration were: "In a lighting territory covered by illuminating gas and the incandescent electric light, which seems to be in the ascendancy?" "Does a fine gas of 23 to 25-candle power help check the invasion of the incandescent electric light?" "What system of electric lighting is best for adoption by gas companies?"

The surplus of the Paris Exhibition of 1889, amounting to 331,405 francs, has been applied to the establishment of an electrical laboratory under the auspices of the Society Internationale des Electriciens. For some time the Society have for the sake of economy accepted the kind offer of MM. Menier and established their laboratory at the works of this firm in the Rue Grenelle. The Paris municipal council have just conceded to the society a site for the better establishment and development of this laboratory, free of all charge, save a nominal one of one franc a year, for the period of 60 years, on the conditions that after this period the whole building to be erected shall become, with its permanent fixtures, the property of the council, and also that the society shall reserve gratuitously two scholarships for electrical students designated by the council for practical course in the laboratory, and that one municipal councillor shall be on the committee of the laboratory.

Although we do not hear very much about the discovery of practical methods of generating electricity direct from coal without the intervention of dynamos and moving machinery, it must not be supposed that workers in the field are idle, says the London *Electrical Engineer*. It will be remembered by scientists that a silver medal was awarded at the time of the Inventions Exhibition for an apparatus of this sort, in which an electrical pressure was obtained from incandescent hydrogen occluded through platinum tubes at a very high temperature. These experiments are being continued, and the results seem to justify the idea—

though in what time it is hardly possible to say—that a practical solution will be arrived at. Prof. Perry has already publicly announced his belief that the experiments will result in a practical method, and these are not the only workers in this extended field.

The University of Pennsylvania has issued a pamphlet relating the advantages of a course in mechanical engineering in that institution and explaining the details of the same. In reference to the department of electrical engineering, it says: "As the greater part of the education of an electrical engineer must be mechanical, and as no mechanical engineering education is complete without a good working knowledge of electrical engineering, a course, extending over parts of two years, has been established in this department. The work begins in senior year with a discussion of quantity, potential, current, resistance, electro-static measurement, magnetism and magnetic measurement, electro-magnetic measurement and the units adopted in practice. The course then treats of the measurement of currents, the construction, calibration and use of galvanometers, the measurement of difference of potential, quantity, resistance, a study of batteries, insulation tests and the apparatus used, the constructing, testing and advantages of different ammeters and voltmeters, measurement of power and efficiency of dynamos and motors, and the efficiency and life of incandescent lamps. The theory of dynamo-electric machines is taken up, and the characteristics of each of the different types are studied. Motors are studied in their theoretical and practical aspects. Lectures are given on electric lighting, wiring on the different systems, and the theory and practical management of accumulators. The course in the electrical laboratory covers the use of all the test apparatus for measuring currents, resistances, insulation and capacity, the testing of dynamos and motors, storage batteries and commercial ammeters and voltmeters. The apparatus in this department is being rapidly increased, and now contains galvanometers, resistance boxes, keys and other apparatus from the best American and foreign makers. The classes are limited in size, thereby having the work of each student carefully overlooked by the instructor in charge."

Business Mention.

R. T. White of 12 Pearl street, Boston, has just issued a little catalogue, descriptive of his improved material for the construction of all kinds of street railway roadbeds.

The Elgin City Street Railway company, which has contracted for the Sprague electric system for its lines, will use two tandem compound Ball engines of 150 horse power each. The order for the engines was obtained by W. B. Pearson, the Chicago agent of the Ball Engine company.

The Electrical Supply company of Chicago has issued a list of Habirshaw wires, cables and cores for which it is Western agent These wires and cables are specially adapted for electric lighting of high or low voltage, underground or under water as well as aerial. Telephone and telegraph cables are furnished on demand.

The Baxter Motor company of Baltimore, reports trade encouraging. Sales of 10 horse power and half horse power motors for Milwaukee, and 4 horse power for Toledo, are reported. The company is negotiating with the Johnstown Electric Light & Power company to install a 150 horse power generator with full equipment of motors.

The United Edison Manufacturing company, Leonard & Izard, agents, have established an office at 202 Griswold street, Detroit, Mich., with Wm. M. Porter, late of the Westinghouse company, as representative, and F. A. Carr, of the Edison company, as superintendent of construction. The object is to have the wiring upon which the Edison lights are to be operated done directly by the Edison company, so that the responsibility for all construction will rest directly upon them. They hope thus to secure better results for their patrons and at the same time feel better satisfied themselves that the work is properly done.

Among the recent sales of engines of A. L. Ide & Sons, Springfield, Ill., are the following: College Park electric belt line, Sherman, Texas, one 100 horse power Ideal engine, boiler and fixtures. Forest City Electric Light company, Rockford, Ill., one 150 horse power Ideal engine. Moffett, Hodgkins & Clarge, Syracuse, N. Y., one 100 horse power Ideal engine (second order); English, Morse & Co., Kansas City, Mo., one 25 horse power and one 40 horse power Ideal engine and two 50 horse power Ide engines; Muscatine, Ia., Gas & Electric Light & Power company, one 65 horse power Ideal engine; Jacksonville, Ill., Gas, Light & Coke company, one 80 horse power Ideal engine (third order); Carroll & Powell, St. Louis, (second order) one 100 horse power Ideal engine; Greenview Coal company, Greenview, Ill., one 50 horse power Ideal engine; W. J. Wilcox Lard & Refining company, New York, one 50 horse power Ideal engine; State Institution for Deaf & Dumb, Jacksonville, Ill., one 50 horse power Ideal engine; Colorado Electric Supply & Motor company, Denver, Colo., one 15 horse power Ideal engine; Peter Schmidt, Milwaukee, one 80 horse power Ideal engine; Detroit Electrical works, for street railway at Fort Worth, Texas, two 150 horse power Ideal engines; Kewanee Electric Light & Power company, Kewanee, Ill., one 80 horse power Ideal engine; United Edison Manufacturing company, Denver, Colo., two 35 horse power Ideals for Ames building at Omaha, Neb.; Medical & Surgical Sanitarium, Battle Creek, Mich., one 25 horse power Ideal engine (second order); Green, Kimble & Tallman, Vernon Center, Minn., one 40 horse power Ide engine; Thomson-Houston Electric company, Chicago, 80 horse power Ideal engine; Springfield (Ill.) Woolen mills, 50 horse power Ideal engine; J. Kennard & Sons Carpet company, St. Louis, one 50 horse power Ideal engine; Springfield (Ill.) Electric Light & Power company, one 125 horse power Ideal engine, and one 125 horse power Ideal compound engine; Bloomington Avenue Presbyterian church Minneapolis, one 35 horse power Ideal engine; Fitzgerald Plaster company, Springfield, Ill., one 65 horse power Ide engine; J. T. Waterhouse, Cedar Rapids, Ia., one 30 horse power Ideal engine.

Electrical Patents.

Issued March 25, 1890.

423 897 Constant Current Motor. Wm. Baxter, Jr., Baltimore, Md.

The invention consists in a constant current motor having the field magnetized by a current shunted from the commutator through two brushes attached to the terminals of the field coils and adapted for changing the electrical relation of the brushes to one another automatically by a centrifugal governor rotated in unison with the motor armature, and therefore affected by the load upon the motor.

423,901. Multiplex Synchronous Telegraph. Robert G. Brown, Brooklyn, N. Y.

423 902. Multiplex Synchronous Telegraph. Robert G. Brown, Brooklyn, N. Y.

423,903 Synchronous Multiplex Telegraph. Robert G Brown, Brooklyn, N. Y.

423,907. Process of Separating Magnetic Particles. Gurdon Conkling, Glens Falls, N. Y.

423,908. Process of Blasting Rock. Lewis D. Conner, Oberlin, Ohio.

423 909. Regulator for Dynamos. Henry W. Cooley, Boston, Mass.

423,912. Commutator Brush. Philip Diehl, Elizabeth, N. J.

Claim one is as follows:

"A commutator-brush consisting of a tube or receptacle and a series of loose contact devices therein."

423 956. Electric Forging-Machine. Robert Ross, Vergennes, Vt.

423,959. Therapeutic Galvanic Apparatus. Theodore Schmauser, Allegheny, Pa.

423,965. Electric Valve-Controller. Elihu Thomson, Lynn, Mass.

423,966. Method of Electric Soldering, Cementing, etc. Elihu Thomson, Lynn, Mass.

The invention consists in passing a heating electric current through a conductor contiguous to the work, but electrically insulated therefrom.

423,967. Apparatus for Electric Soldering and Cementing. Elihu Thomson, Lynn, Mass.

423,975. Controller for Electric Motors. Merle J. Wightman, Lynn, Mass.

The sixth claim is appended:

"The combination, with an electric motor, of a circuit breaker and closer in the connection between the same and a suitable source of energy, short-circuit connections for a coil or conductors on the field-magnet of the motor, and a supplemental switch to whose contacts such connections are carried, said supplemental switch being actuated by the first at the instant before the rupture of the circuit of the motor.

424,991. Dynamo-Electric Machine. Sebastian Z. de Ferranti, Hampstead, County of Middlesex, Eng.

424,006. Telegraphy. Charles Langdon-Davies, London, Eng.

424,012. Electro-Medical Chair. Marian A. MacMaster, Utica, N. Y.

624,027. Igniting Apparatus for Gas Engines. Edward F. Roberts, Rochester, N. Y.

424,036. Electro-Magnetic Motor. Nikola Tesla, New York, N. Y.

The second claim is:

"In an alternating current motor, the combination, with an armature-core circular in configuration, of a supporting-frame, field-cores extending therefrom over portions of the periphery of the armature, and energizing-coils surrounding said armature, and parts of the field-cores.

424,047. Electric Radiator. Henry R. Butterfield and Willis Mitchell, Waterville, Me.

Claim three reads as follows:

"In combination with an inner open frame, a wire openwork surrounding the same and insulated to guard against short circuiting, the wire of said openwork forming part of an electric circuit as one continuous conductor and allowing the free passage of air through it."

424,057. Underground Conduit for Electric Wires or Cables. Charles G. Gilman, Eldora, Ia.

The invention relates to underground conduits for electric wires or cables; and it consists in the combination, with the metallic pipes arranged to contain the wires or cables, of an insulating sheathing and an intermediate filling.

Claim one is:

"An underground electric conduit-pipe consisting of an inner metallic pipe inclosing the wires, an outer tube of porous earthenware, and an intermediate layer of asphaltum."

424,065. Dynamo-Electric Machines. Chas. D. Jenney, Indianapolis, Ind.

The last claim is appended:

"4. The combination, in a dynamo-electric machine, of the field-magnet core, an armature located to one side of said core, and pole pieces secured to the ends of said core, expanding in the direction of the axle of the armature, and extending from the ends of said core in substantially the natural direction of the principal lines of force of the field-magnet to near said armature."

424,070. Electric Locomotive. George W. Mansfield, Boston, Mass.

Claims thirteen and twenty-six are:

"In an electric locomotor, a swinging collapsible frame for supporting the motor.

"The combination, with an electric-railway car, of a propelling electric motor therefor, supported at one end upon the axle of the vehicle and borne at its other end by an elastically-sustained sliding support."

424,082. Electric Railway. Walter Thompson, Meriden, Conn.

424,110. Coupling for Trolley Wires Samuel Harris, Cleveland, Ohio.

424,152 Secondary Battery. Harry H. Wardwell, Lake Village, N. H.

424,182. Circuit-Closer. Joseph A. Dempf, Washington, D. C.

424 206. Electric-Railway Car. Rudolph M. Hunter, Philadelphia, Pa.

424,207. Electrically-Propelled Vehicle Rudolph M. Hunter, Philadelphia, Pa.

424,209. Quadruplex Relay. Francis W. Jones, New York, N. Y.

424,219. Electric Alarm for Letter Boxes. Wesley G. Reed, Toronto, Ontario, Can.

424,229. Fuse-Plug. John A. Seely, New York, N. Y.

424,268. Electro-Magnetic Watch-Clock. Rufus B. Carr, Boston, Mass.

424,273. Electric Time-Dial. Charles A. Colby and Jas. C. Strong, Buffalo, N. Y.

424,295. Electric Stop-Motion for Knitting-Machines. John P. Haslam, Wilmington, Del.

424,298. Electric Railway. John C. Henry, Kansas City, Mo.

424 310. Multiple Switch-Board. Milo G. Kellogg, Hyde Park, Ill.

424,338. Electric Meter. William McKinney, Philadelphia, Pa.

424,339. Isolated System of Electric Lighting. James F. McLaughlin, Philadelphia, Pa.

The invention consists of a hydraulic motor, a dynamo electric generator driven by the same, a secondary battery adapted to be discharged by the dynamo and to discharge into the light circuits, and a combined switch and valve for simultaneously controlling the circuits and the feeding water for the motor.

424,340. Electric Railway. James F. McLaughlin, Philadelphia, Pa.

The eighth claim: "In an electric railway, an underground conduit disposed below the center of the road-bed and parallel therewith, said conduit being composed of spaced metallic ribs connected by webs at their lower ends, with slots in each rib and metallic sheathings sprung into said slots, and constituting the walls of the conduit."

424,364. Electric Railway. Edmund P. Slentz, Idlewood, and James B. McGrew, Pittsburg.

By this invention the conducting strips from which the car takes its power are rendered dead or inactive throughout the entire length of the route, except for a short distance corresponding, approximately, to the length of the car, which (the car) as it advances over the track gradually and automatically, shifts the active portions of the conducting strips from one section of the same to another from the beginning to the end of the track, and in advance of the line of travel. The progressive "rendering active" by sections of the conducting strips which supply the car with power for its propulsion is accomplished automatically and mechanically by the car itself.

424,371. Removable Truck for Electric Cars. John Stephenson, New York, N. Y.

424,372. Electric Car Truck. John Stephenson, New York, N. Y.

424,373 Electric Car Truck Frame. John Stephenson, New York, N. Y.

424,374. Trolley-Bridge. John Stephenson, New York, N. Y.

424 380. Combined Conduit and Overhead System for Electric Railways. Charles J. Van Depoele, Chicago, Ill.

Of the twenty-four claims the last is given: 'In an electric railway, the combination, with a suspended conductor, of a vehicle having a contact-carrying rod or arm extending to the suspended conductor, a tension-spring engaging the lower portion of said arm for imparting upward movement to its outer end, a weight connected with said spring for placing the same under tension, and a removable support for sustaining the weight when said contact-arm is not in use."

424,381. Trolley Arm for Electric Railway Cars. Charles J. Van Depoele, Lynn, Mass

424,387. Burglar Alarm. Nelson M. Watson, Ecorse, Mich.

424,401. Electric Meter. William J. Bagby, Atlanta, Ga.

424,403. Electric Heating and Cooking Device. Henry R. Butterfield, Waterville, Me.

424,404. Electric Flat-Iron. Henry R. Butterfield and Willis Mitchell, Waterville, Me.

424,406. Commutator. William F. D. Crane, Philadelphia, Pa.

424,431. Municipal Signaling-Box. Frederick Pearce, New York, N. Y.

424,436. Electric Railway Motor. Frank J. Sprague, New York, N. Y.

424,441. Method of Manufacturing Projectiles by Electric Welding. William M. Wood, Washington, D. C.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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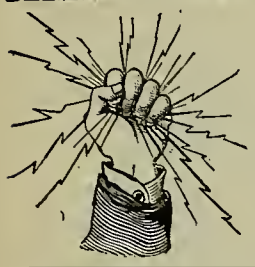

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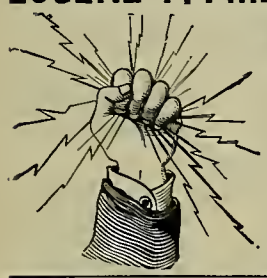

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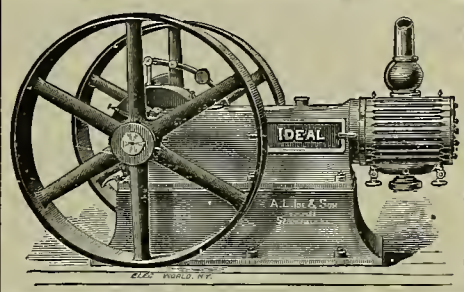

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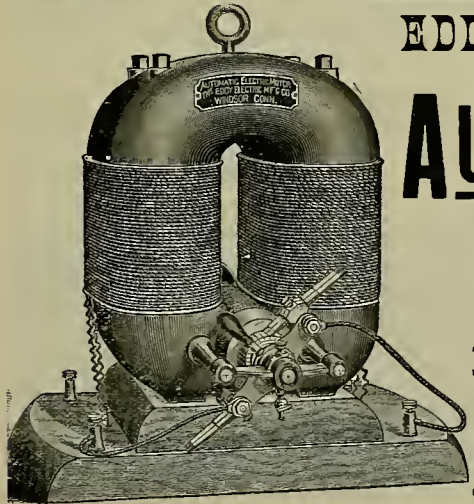

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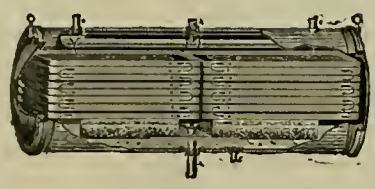

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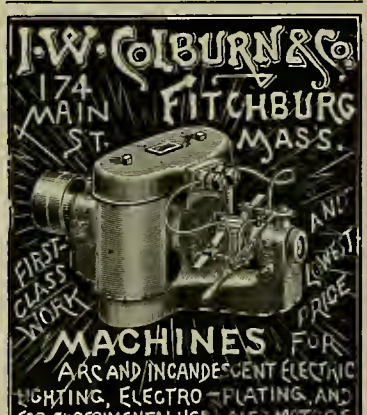

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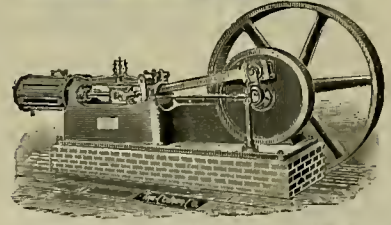

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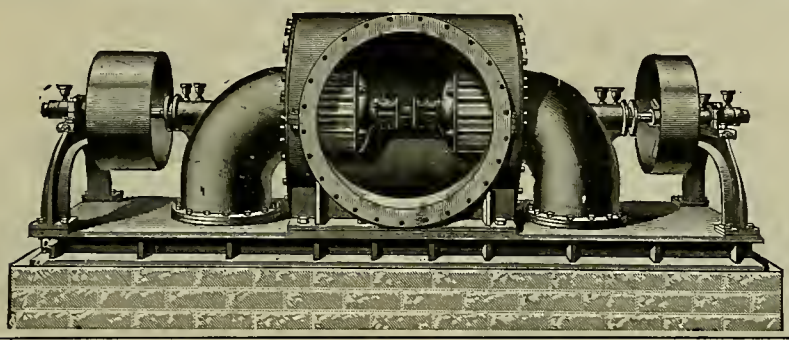

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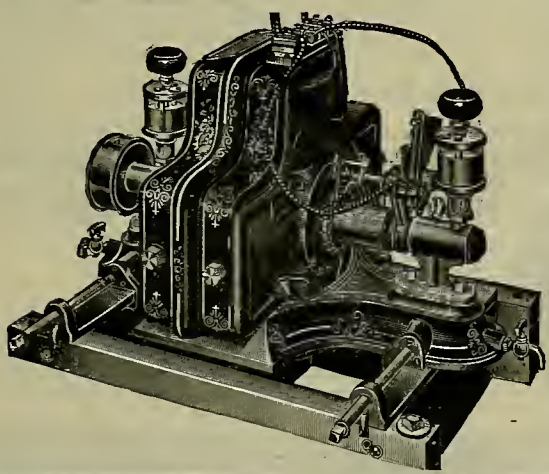

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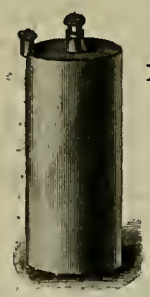

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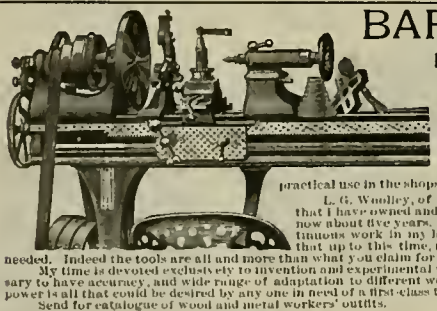

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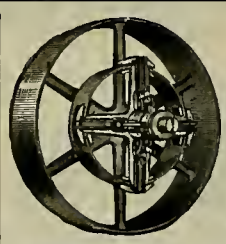

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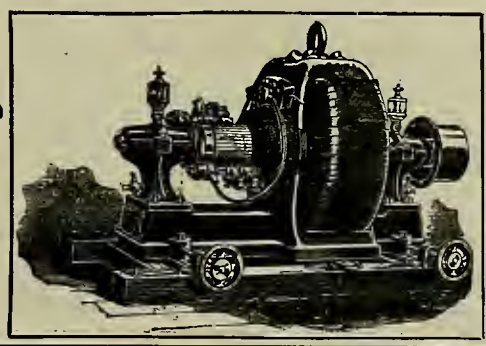

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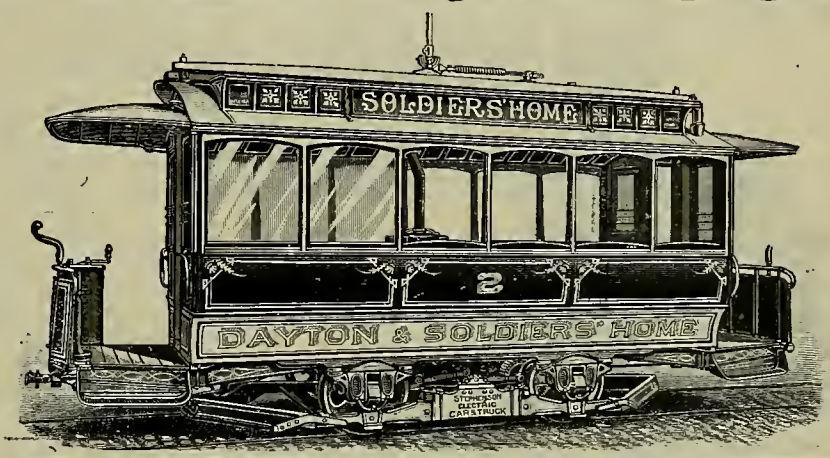

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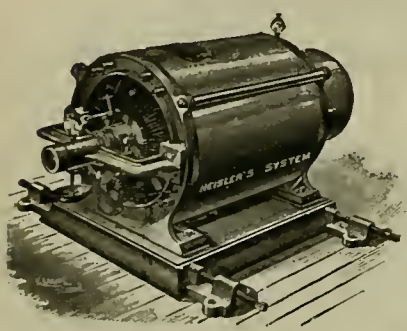

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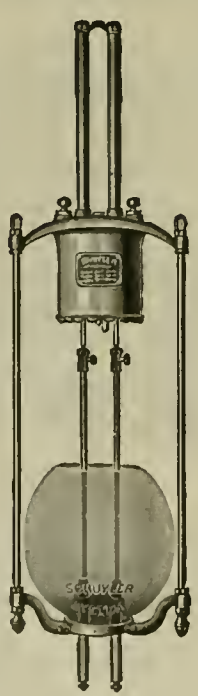

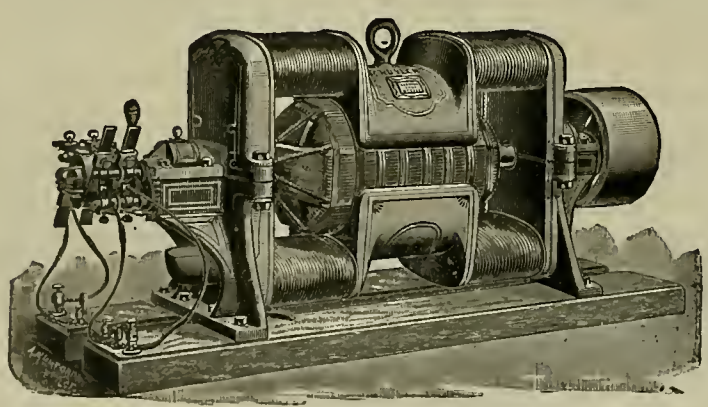

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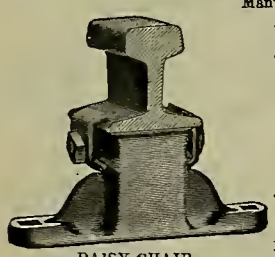

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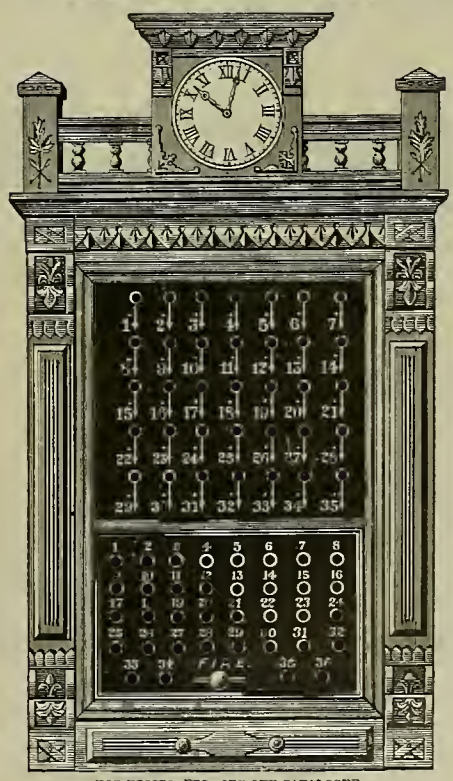

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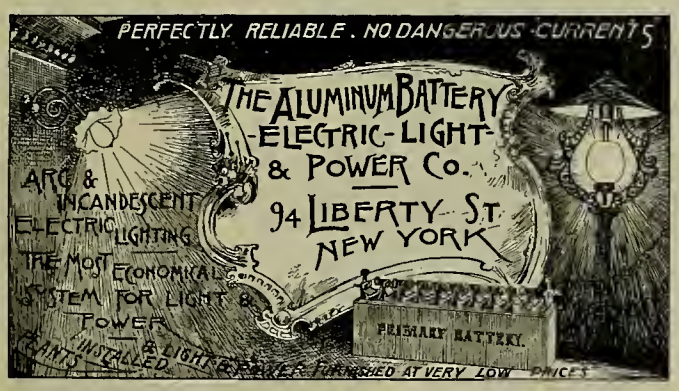

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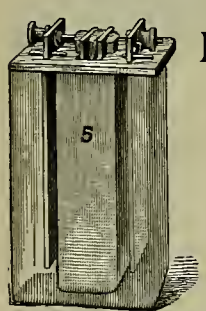

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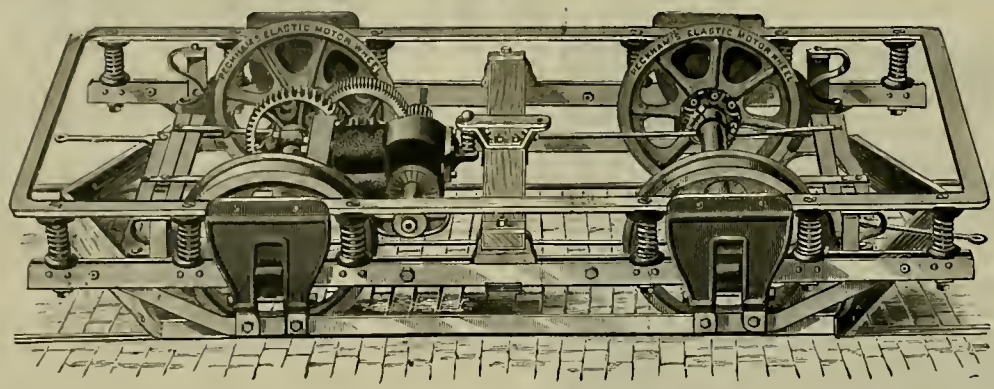

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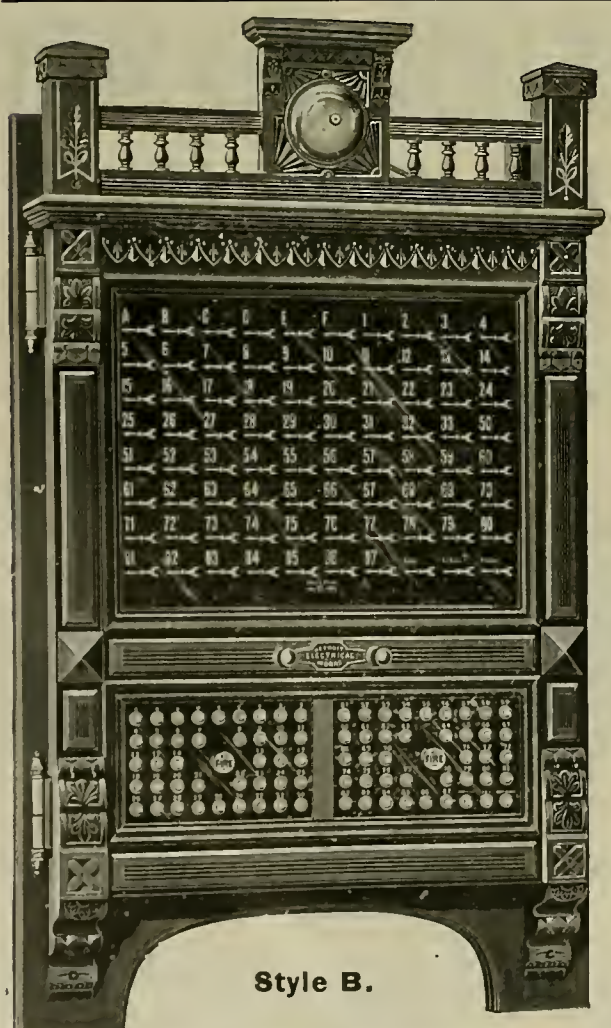

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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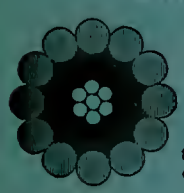

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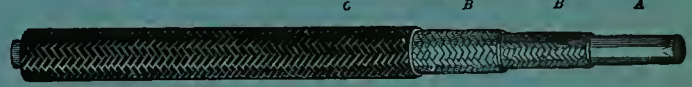

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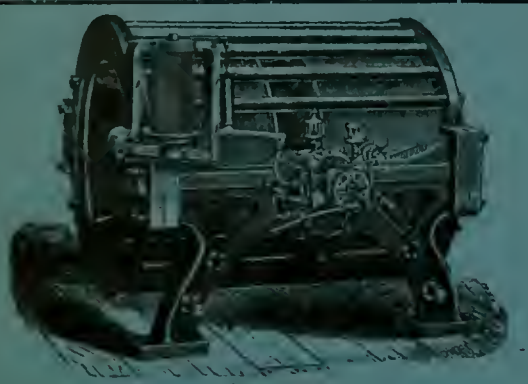

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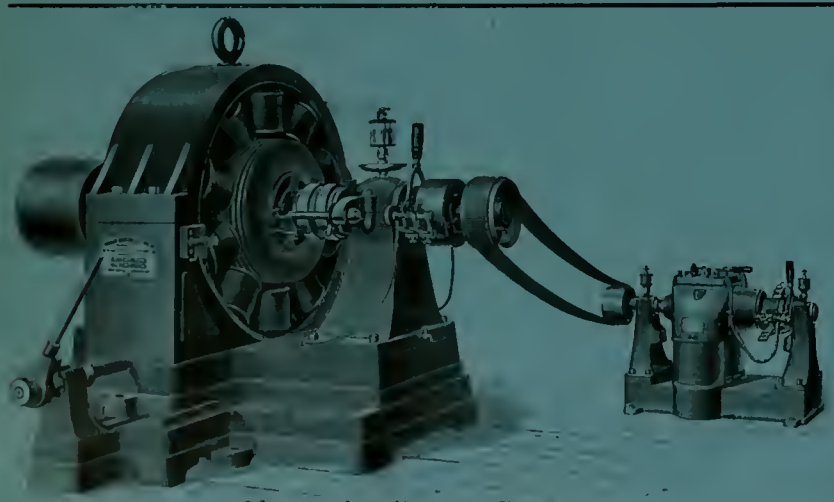

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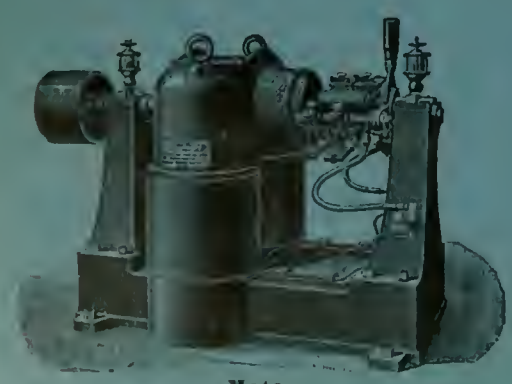

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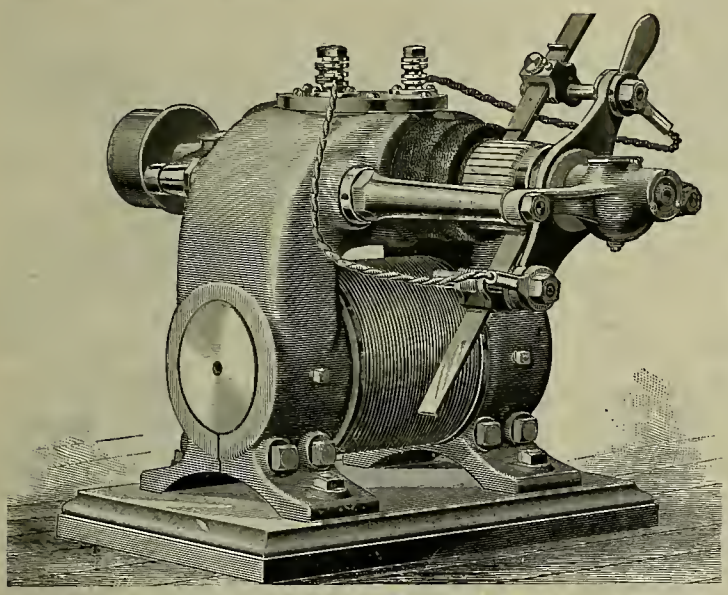

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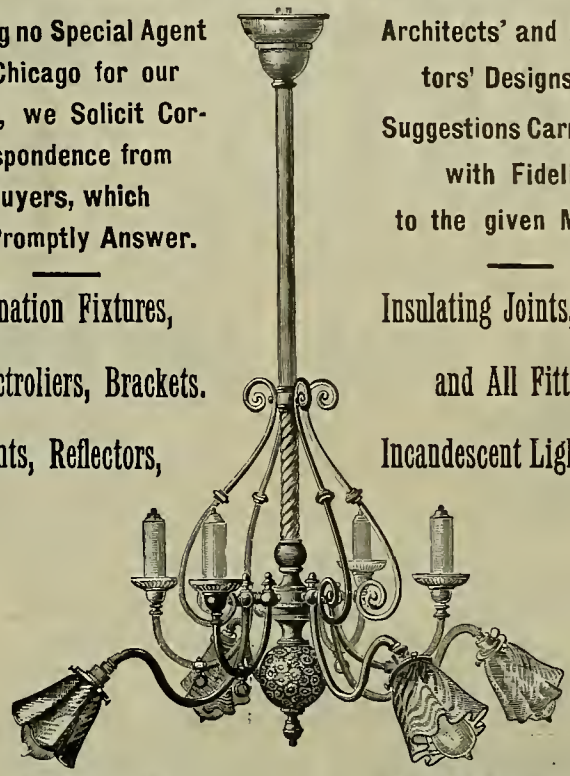

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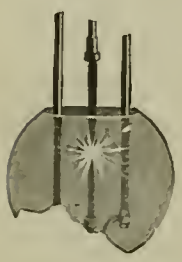

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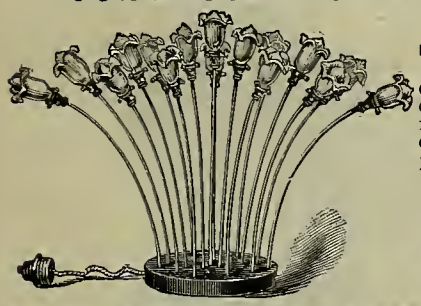

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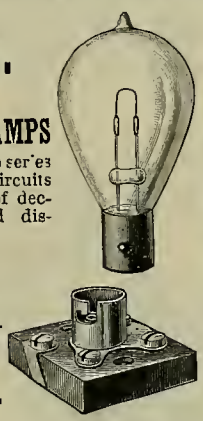

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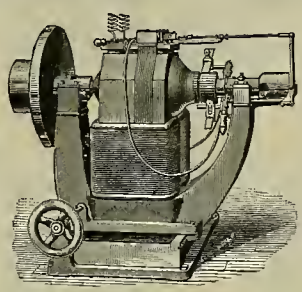

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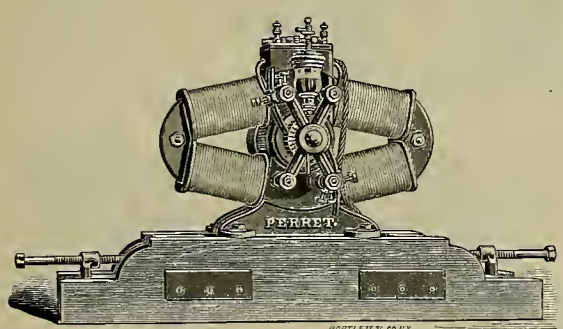

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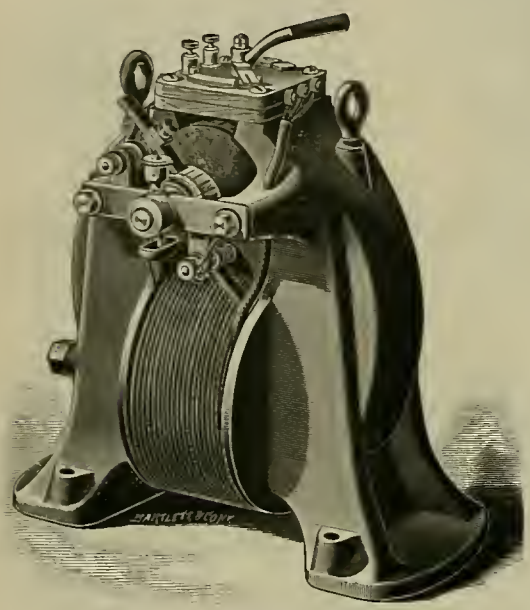
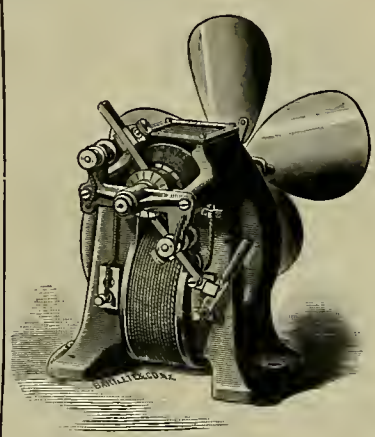
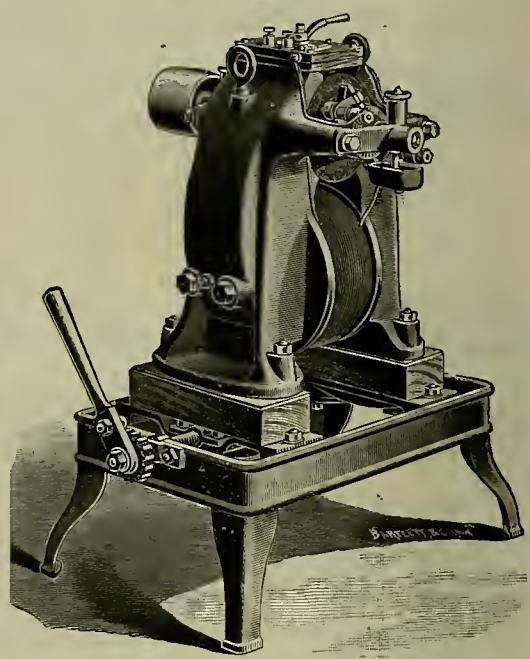


MOTOR WITHOUT BASE.



FAN MOTOR.



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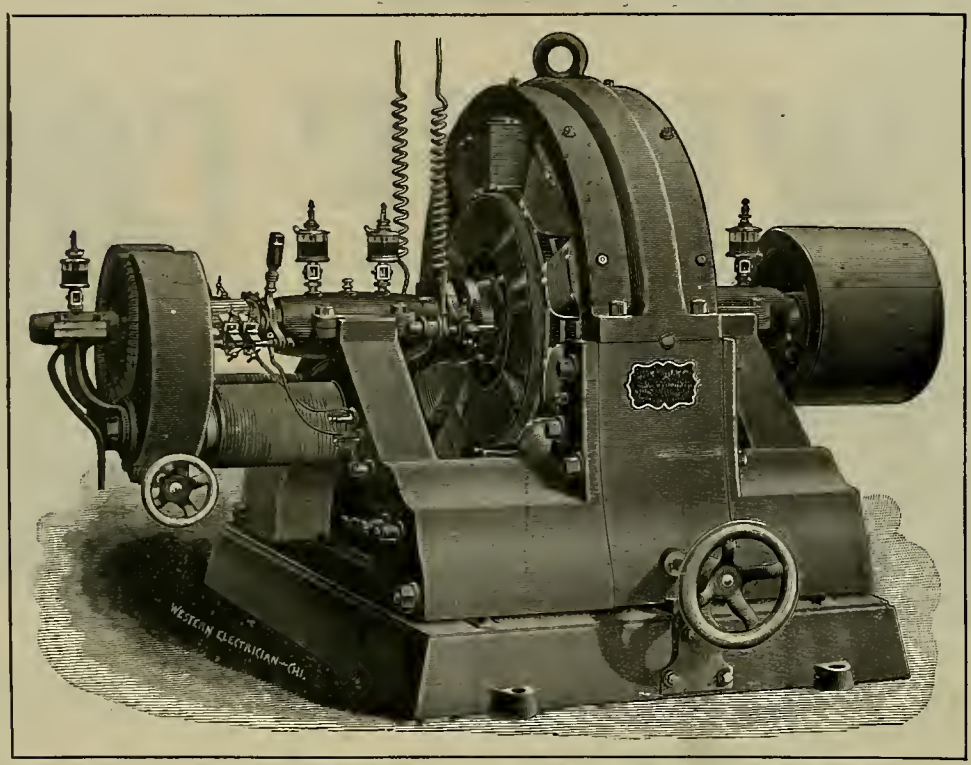

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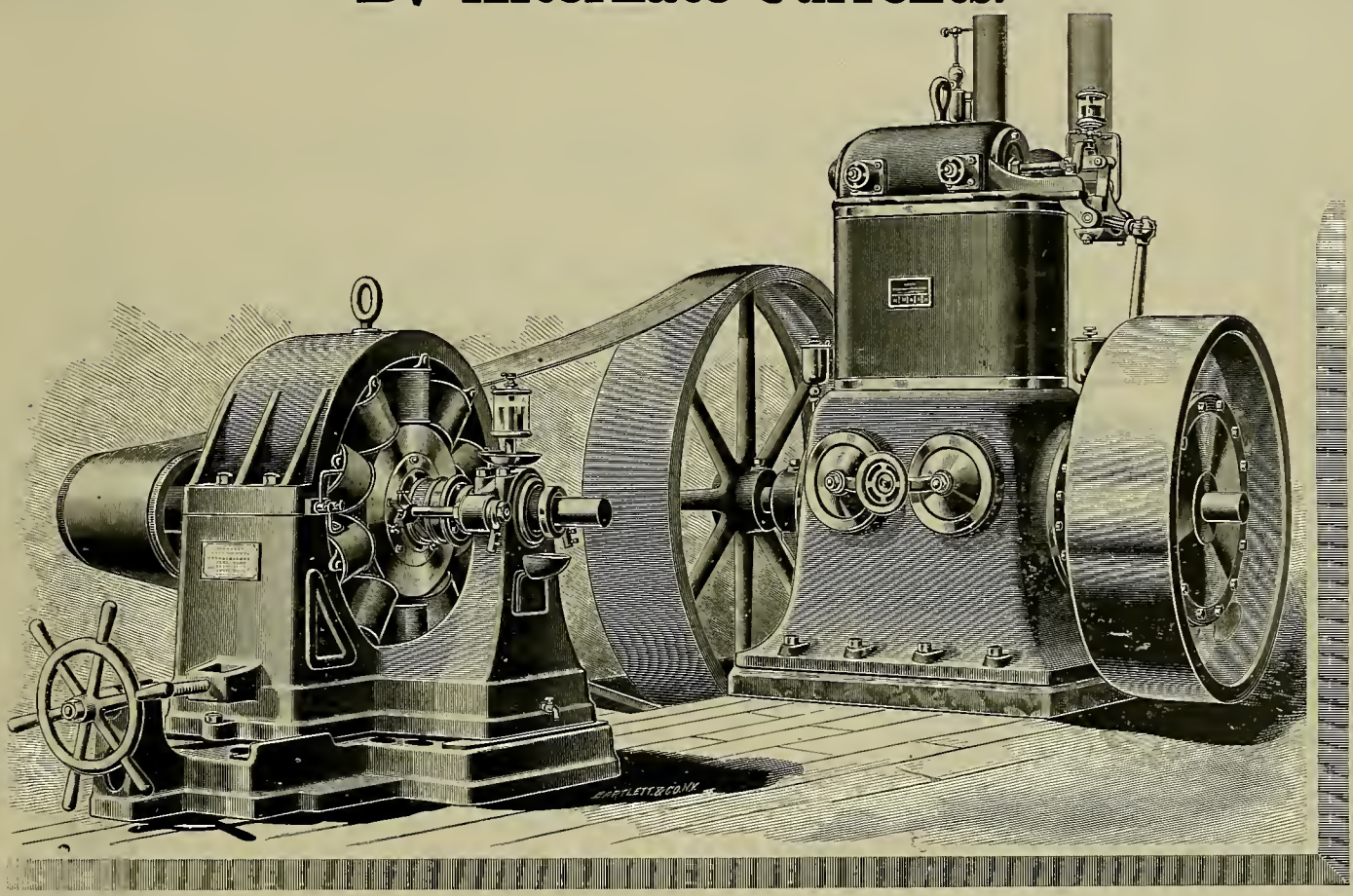

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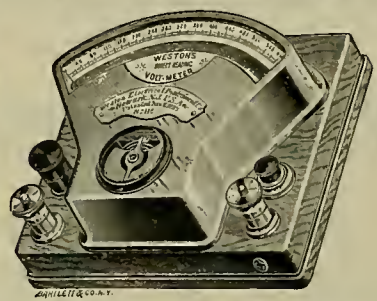

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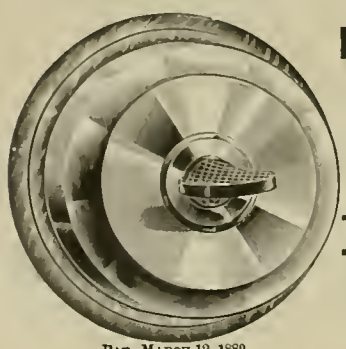

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Western Electrician.

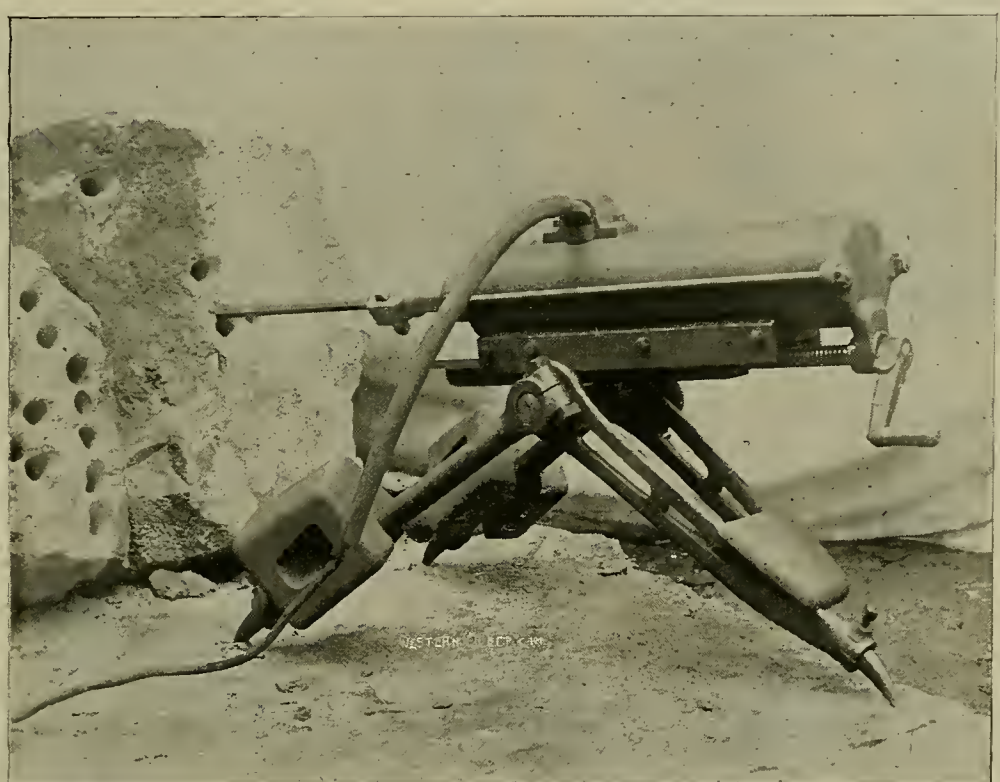
EVERY SATURDAY.

Vol. VI. CHICAGO, APRIL 12, 1890. No. 15

Electric Percussion Power Drill.

The Marvin electric percussion power drill, which is shown in the accompanying cut, is operated by a direct electric current. The drill which has been needed in mining work, has been recently perfected, and is adapted to all classes of rock cutting and quarry work.

No class of machinery is subjected to greater wear and abuse than rock power drills. The construction of the device shown in the cut is such that it can withstand such treatment. It is very simple in its design; there are no electrical moving contacts about the machine, and nothing corresponding to a valve action, as in the steam and air power drills now in use. Being compact and solid with no exposed parts it cannot be readily injured in any way by inexperienced handling.



ELECTRIC PERCUSSION POWER DRILL.

It possesses the feature of automatically shortening its stroke when withdrawn out of striking range of the rock, and reducing it to a mere quivering motion. This result is obtained without the use of buffers of any kind, being due entirely to magnetic influences.

The Marvin drill has a normal stroke of about four inches, but by feeding the machine up to the rock, this may be reduced to a quarter of an inch. It is thus possible to start the bore on a slanting surface without handdressing, which gives a great economy in time and labor. Machines are built both for the lightest plug and feather work, and those fitted for the heaviest open cutting and tunnel excavation. The machines are controlled by the Sprague Electric Railway & Motor company.

To Utilize the Power of Niagara.

The Cataract Construction company, which proposes to build a tunnel around Niagara Falls, and to run machinery in factories by means of water power, signed contracts last week with the Niagara Falls Power company. The contracts are not to take effect until some minor difficulties are overcome. By this it may be understood that some people still refuse to sell their land to the company. The options on most of the land wanted expired March 31, and representatives of the company were busy until after 2 A. M. on the following day.

Deeds showing the transfer of over $100,000 worth of property to the Cataract Construction company were filed in the county clerk's office April 1, and many more are to follow.

The Cataract Construction company is an organization formed under the laws of New Jersey. Its officers are New York men. Edward A. Weeds is president, F. L. Stetson vice-president, and W. B. Rankine secretary. The work of constructing the tunnel will be begun, it is said, as soon as the machinery can be procured.

The land for miles about the village has been purchased by speculators, who expect to profit by the boom which they are sure is coming. The company is privileged by act of legislature to furnish electricity for light, heat and power throughout Niagara and Erie counties, and has also obtained other valuable rights. It has purchased the stock of the local water company, and will establish a new plant.

Proposed Inspection of Electric Plants by Chicago Underwriters.

Chicago underwriters have been considering the question of securing inspections of all electrical wires and appliances in buildings upon which they have risks, and they have appointed a committee to look into the matter, with a view of employing special inspectors for that purpose. The general introduction of the electric light in office buildings, factories, salesrooms and storerooms, as well as public buildings, hotels, etc., in Chicago, has led the underwriters to give this matter their attention.

It is a complimentary tribute to the construction work of Chicago electric companies that the necessity of this step has not impressed itself upon the Chicago underwriters before, and even now, although the question has been before them for some time, it is not deemed probable by many of the members that anything will be done. This is due to the fact that Chicago has been singularly free from fires, the origin of which could be traced to electric wires. Chicago's underground system has had much to do with this, no doubt; and the watchfulness of City Inspector Haskins is another guard upon which much reliance is placed.

The question of inspection has been agitated by Charles Squires, manager of the inspection department of the Chicago Fire Underwriters' association. In his last annual report he strongly urges the members to consider this matter at once. His position is sustained by the president, and there seems to be no opposition in the board, but the members have allowed the matter to drift along, as there appears to them no reason for immediate action. The question of compensation has likewise been discussed. Some of the members believe the city should employ additional inspectors, but as there are no immediate prospects of such an innovation it is quite likely that the association will be obliged to pay the electrical inspectors in the same manner as those they now employ. It should be added that this latter course is advocated by Mr. Squires. He says he believes the only way the present efficiency of the inspection department can be maintained is by following the same policy that has hitherto obtained.

"If we desire to direct the action of the inspectors," he said, recently, to a WESTERN ELECTRICIAN representative, "and if we would maintain our own independence, we must pay for the inspectors." He did not approve the system in vogue in the East—especially in Boston and throughout New England where the salaries of inspectors are paid by the electric companies. He had given this question much attention, he said, and had examined various methods and propositions and had come to the conclusion that it would be a good thing for the property owners, the electrical companies and the underwriters to establish a system of inspection by experts under control of the underwriters, and that these inspectors should be employed by the association, and not dependent in any way upon the electrical companies.

The Westinghouse Electric company recently closed an order for a 750 light alternating current incandescent dynamo to go to the town of Girard, Kan. The company buying the incandescent machine has also decided to invest in a 25 light arc dynamo of the Westinghouse company's new type.

New Hawkeye Dynamo.

The new incandescent dynamo of the Hawkeye Electric Manufacturing company of Davenport, Ia., is illustrated in the accompaning cuts.

The Hawkeye company states that its new type of dynamo, of which a front view is shown

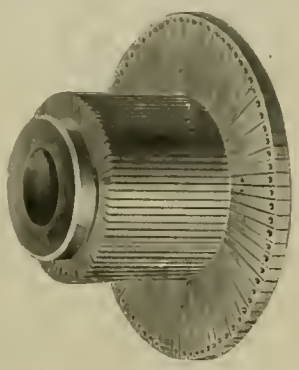


FIG. 4. NEW HAWKEYE DYNAMO.

in Fig. 1, has proved an extremely efficient machine. It is, the company asserts, non-sparking, whether lightly or heavily loaded and is automatic under all conditions of load. Fig. 2 gives a rear view of the dynamo.

Fig. 3 shows the armature, commutator, dynamo pulley and shaft complete. Fig. 4 shows

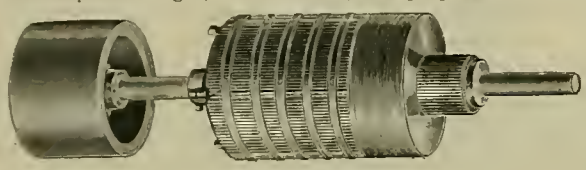


FIG. 3.

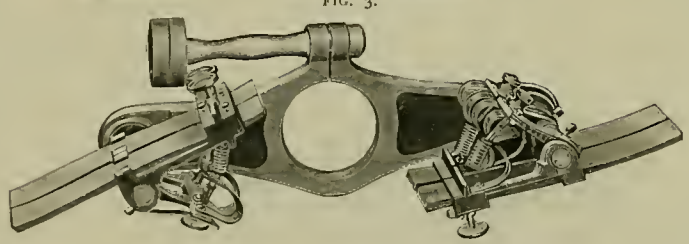


FIG. 5. NEW HAWKEYE DYNAMO.

the commutator, which is made of drop forged copper bars. Mica insulation is used exclusively in the commutator.

The rocker arm and the new form of brush holder are show in Fig. 5. The brush holder clamps the brush at a point about an inch from the commutator. It is possible to use the brush therefore, even when it has become short. Fig. 6 shows the brush holder with the brush in position, and in Fig. 7 the brush holder alone is shown.

Proposed Tariff on Mica.

Among the provisions of the McKinley tariff bill is a proposition to levy a tax of 35 per cent. on all imported mica. This will work a great injustice to electrical manufacturers in this country. There are very few mica mines in the United States, and the product of these is consumed by stove makers. The quality of the product of these mines is so inferior that it is not suitable for electrical work, hence it will be necessary for them to import mica or find a substitute. There is no inclination on the part of the stove makers to use the imported article, and there is apparently no excuse for the present action of the McKinley committee.

A Chicago dealer in mica said a few days ago to a representative of the WESTERN ELECTRICIAN: "The market will advance about 15 per cent., I believe, on account of this proposed imposition of duty on the imported product. Nearly all the imported mica is used in the manufacture of electrical apparatus, where a superior grade of mica is required. The American product is of inferior quality and not suitable for electrical work."

A writer in the New York *Times* says: "Mica has always been on the free list, and it is further a peculiar fact that the electrical manufacturers cannot use the infant home-produced mica, even if they were to get it for nothing, whereas, the stovemakers can use the home product. Now, then, it is proposed to tax mica 35 per cent., which will have the effect of taxing the electrical manufacturers 35 per cent. on the use of foreign mica, that they are bound to use, which tax goes into the treasury, now overflowing with a surplus; and on the other hand, it will raise the price of home-produced mica 35 per cent., used by the stovemakers, for the benefit of the home producers of mica. This is the innocent little game. True, the tariff swindle on this article is small, but it is so sweet and so ludicrous!"

Electric Railways at Milwaukee.

The first electric car operated in the city of Milwaukee was started last week and run over the line of the West Side Street Railway company. The start was made in the presence of a crowd of interested spectators who hailed with delight the appearance of the motor car, the first substantial evidence that the city had at last secured a system of rapid transit. After the lines had been tested and some preliminaries

FIG. 6. NEW HAWKEYE DYNAMO. FIG. 7.

had been arranged, the start was made with the officials of the road and a few outsiders on the car. The trial trip was made without event, and the system was then tested thoroughly. This road is equipped with an overhead Sprague system. It has proved thoroughly satisfactory thus far. The Hinsey lines are not yet operating.

Method of Repairing Short-Circuited Condensers.

J. J. O'Connell, electrician of the Chicago Telephone company, writes as follows in regard to crossed condensers: "We have been obliged to abandon a considerable number of condensers in telephone work because they became crossed and short circuited. Lightning whenever it strikes a condenser will almost invariably cause a cross. While experimenting recently I ascertained an easy way of removing a cross in a condenser. It consisted simply in passing a current of about 20 amperes through the condenser until the tin-foil was fused at the point where the cross existed. The remedy has proven so effective that a cross never reappears at that point in the condenser again. After I removed crosses from a condenser recently by this means, I endeavored by the discharge of an induction coil to cause them to return, but found I was unable to do so. A great many crossed condensers might be fixed by this simple remedy, so I present it for the benefit of the readers of the WESTERN ELECTRICIAN. I may say that I used 110 volt Edison current in the experiment."

Quotations No Longer Furnished.

The Chicago Board of Trade last week discontinued sending out quotations, hoping thereby to effect the closing up of the bucket shops. All the telegraph instruments were removed from the floor of the board, but the outside operators continued to secure quotations through some unknown channel. The only effect thus far apparent is the inconvenience to members. The New York brokers claim that the action of the Chicago board will eventually drive most of the business now conducted through Chicago into other channels, and they are accordingly jubilant. The New York *Sun* says: "It is but another step in the effort of the Chicago Board of Trade to crush the bucket shops east and west of the Alleghanies. All the New

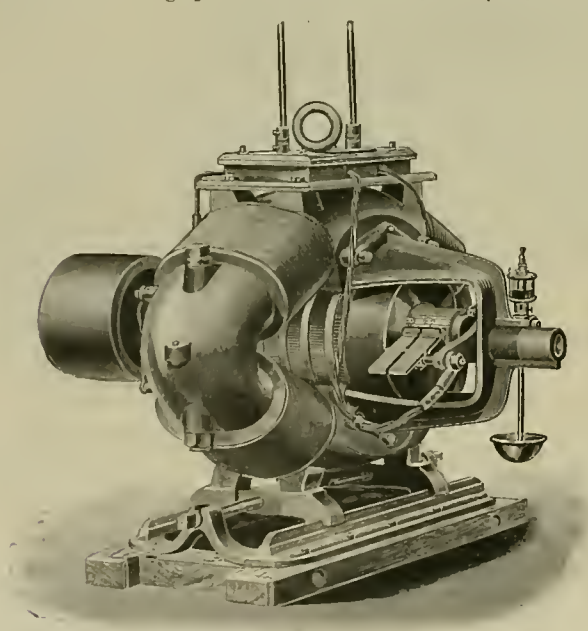


FIG. 1

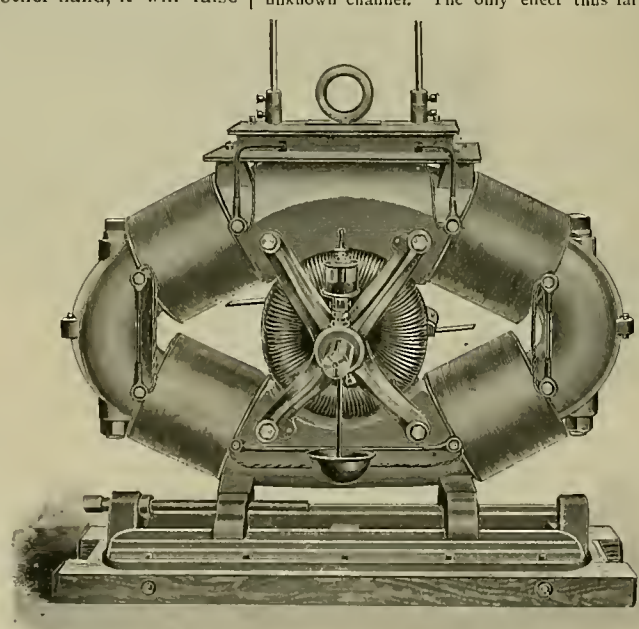


FIG. 2.

NEW HAWKEYE DYNAMO.

York banking houses with private wires to Chicago and representatives on the floor of the Board of Trade will continue to receive the quotations. The Produce Exchange managers were not at all disturbed by the news. In fact, they said they rather liked the situation, and they would now put forth efforts to have the New York prices circulated all over the country, and do everything legitimate to have these prices take precedence over the Chicago figures. Another point was that they felt that New York speculators would now do more business on the Produce Exchange. Most of the great orders have hitherto gone to Chicago."

New Electrical Devices.

In the accompanying cuts are represented two electrical devices recently put on the market by the Western Electric company, Chicago.

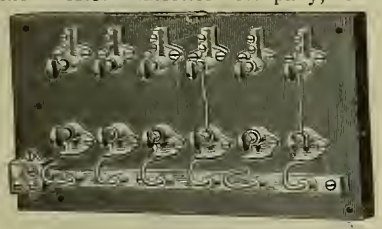


FIG. 1.

NEW ELECTRICAL DEVICES—MULTIPLE CUT-OUT BOARD.

Fig. 1 shows a multiple cut-out board and Fig. 2 a lightning arrester. In the multiple cut-out switch all metal parts are secured to the base by screws passing through the metal into the

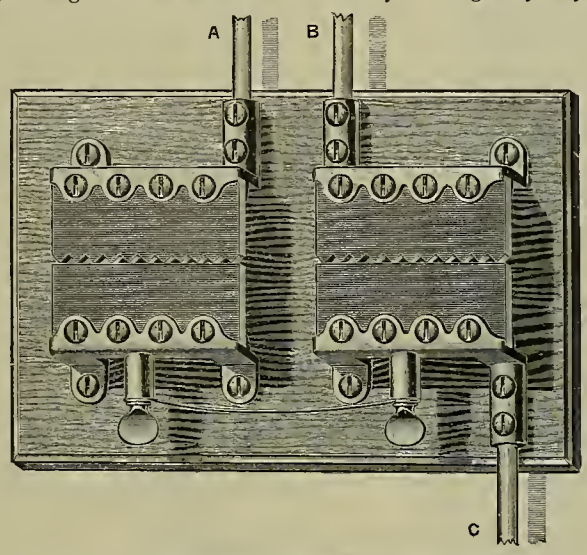


FIG. 2. NEW ELECTRICAL DEVICES—LIGHTNING ARRESTER.

base, no bolts of any kind being allowed to pass through the base. The bar or strip lying along the lower edge of the board is provided with curved spring switches which, when closed, are held firmly in place by a slight indentation or notch upon the lower surface of the contact base. Whenever it is desired to insert a fuse wire or to test a circuit, the spring switches upon both the positive and negative sides, can be, quickly opened for either purpose. Special attention has been paid to the requirements necessary to insure safety, while at the same time the construction is such as to render it cheap and serviceable. These boards are manufactured in sizes to suit the varying requirements, ordinarily from four circuits up to fourteen.

The lightning arrester is provided with a cut-out, or safety strip, to prevent permanent short-circuiting of the dynamos; also with carbon discharge plates that will, it is claimed, withstand the effect of numerous discharges of lightning with very little damage, at the same time insuring protection to the dynamos from injury by lightning.

An Electric Trap.

Among the American patents recently issued was one granted to F. Scherer, a resident of Paris, for an electric trap. The device is designed to put a speedy end to all manner of obnoxious crawling and flying creatures. The trap consists of a lure or bait located behind a grid composed of metal rods or wires, which are arranged side by side, forming the positive and negative wires of the circuit. When a rat, for example, seeking the bait, comes in contact with the grid, the circuit is closed, and the rodent's desire for the bait immediately departs. There is no apparent reason why the trap should not be effective, though it would hardly pay to keep a high tension dynamo in operation simply in the hope of playing an electric joke on a rat.

Proposed Electric Railway at Aurora, Ill.

A number of eastern capitalists have been visiting promising towns in Illinois with a view of establishing electric light and power plants and electric railways. A special dispatch from Aurora says: "The prospects are good for an electric street railway in Aurora within a few months. Eastern capitalists have representatives here who have submitted a proposition to the city council, offering, in return for a few modifications in the present street railway charter, to build and equip twelve miles of electric street railway in the city within twelve months. The system to be used will be the overhead trolley system, and a speed of fifteen miles an hour will be gained outside the fire limits. The poles will be 135 feet apart and twenty-one feet above ground, and in addition to this the company proposes to furnish power and illumination."

The Walker Electric Meter.

The importance of having a meter that will correctly record greatly varying amounts of current passing through it for an extended period, is admitted by those interested in the distribution of electricity. Ampere meters of various kinds have been devised in which the needle or indicating part of the instrument records its

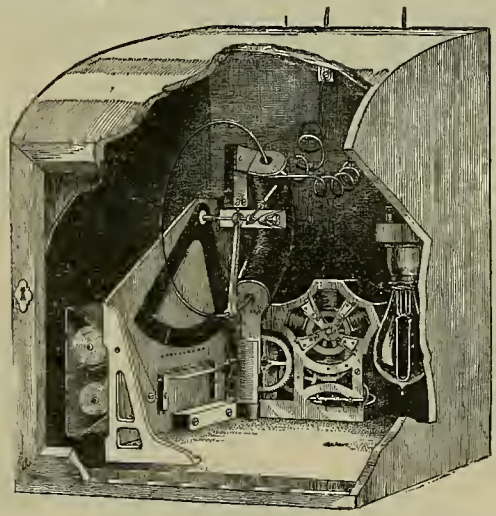


FIG. 1. WALKER ELECTRIC METER.

actions by means of a syphon pen or a pencil. These parts, however, do not always work satisfactorily. The ink in the syphon sometimes fails to flow, or the pencil sticks. A meter in which, it is claimed, such defects are overcome is illustrated in the accompanying cuts. The meter, Fig. 1, consists of a current indicator, having the form of a curvilinear solenoid magnet, the core of which is more or less attracted proportionately to the rate of consumption of the electric current. A photographic recording device, shown in Figs. 1 and 2, prints on a roll of chemically prepared paper a scale of ampere-hours, or lamp-hours, while simultaneously recording on this scale the position of a pointer attached to the core of the solenoid. The roll of paper is continuously moved at a slow rate, whenever current is being consumed, by means of an ordinary clock movement. This is automatically started and stopped, as well as wound every hour when in use, by the current to be

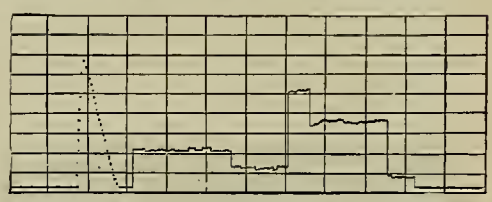


FIG. 3. WALKER ELECTRIC METER.

measured. From the record on this slip of paper, which is illustrated in Fig. 3, the quantity of current consumed during any predetermined interval of time may be ascertained by a simple computation. As the whole current to be measured passes through this meter, it is necessarily free from those errors due to changes in temperature, to which instruments depending on shunt devices are liable.

The loss in operating the meter, too, is confined to the energy to burn one lamp in the meter, which at the candle power used takes one-sixteenth of an ampere. This is the maximum loss whether the current for one or a thousand lamps is measured.

One of the features of the machine is the frictionless character of the recording device. The difference between such an arrangement as this and one in which the core or the pointer is required to perform work, such as marking a line, is evident. This meter is introduced by the Walker Electric company of New York.

Resistance of Conductors to Transient Currents.

Continuous current workers will find the following item from the London *Electrician* to be of interest: At the last meeting of the Royal Society of Edinburgh, Sir William Thomson read a paper recounting an accidental illustration of the effective ohmic resistance to a transient electric current through a steel bar. He said that at the recent meeting of the British association at Newcastle Lord Armstrong had told him of an interesting incident. A bar of steel about a foot long, which he (Lord Armstrong) was holding in his hand, was allowed accidentally to come in contact with the two terminals of a dynamo. He instantly felt a painful sensation of burning, and he let the bar drop. He found his fingers where they had been in contact with the bar severely blistered. The bar was found immediately

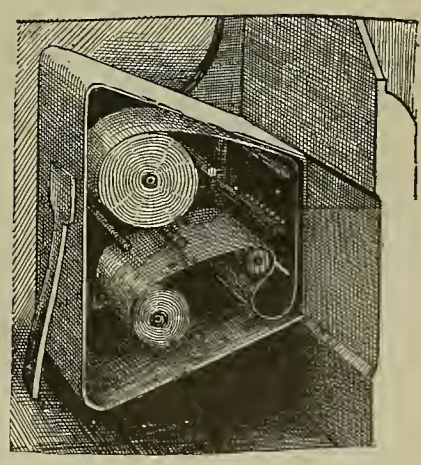


FIG. 2.

afterward to be quite cold. This proved the outer surface of the steel to have been intensely heated, and that not enough of heat was generated to sensibly warm the whole bar. Lord Armstrong had sent him the bar and some further details. There were two hollows burned out of the metal at the points where the bar touched the terminals of the dynamo. Lord Armstrong had held the bar midway between the two marks. It was perfectly cold three or four seconds after he dropped it. The dynamo

gave a continuous current of 85 amperes, at a difference of potential of 103 volts. Sir William Thomson then showed how the theory involved could be worked out by Maxwell's fundamental equations of electro magnetism. He discussed the theory at some length, and showed that there was a thermal analogy.

The Representative of Electric Light.

The greatest event in the history of Brookings, South Dakota, according to the local papers, was the Merchants' Carnival which took place in that city a few nights ago. During the course of the festivities at the opera house every industrial enterprise in the thriving town was illustrated by a lady dressed in an appropriate costume representing some distinct feature of the industry. Of course the electric light company's exhibit carried off the honors of the evening. Its representative was Mrs. E. E. Gaylord, wife of the manager and electrician of the Brookings Electric Light company. The

ELECTRIC LIGHT REPRESENTATIVE.

accompanying portrait gives a general idea of the installation. As a representative of the electric light Mrs. Gaylord wore a crown of incandescent lamps and her dress was decorated with the same ornaments. The lamps were all properly connected, the wires terminating in the heels of the shoes. On the floor of the stage were two small copper plates connected to a small dynamo. When Mrs. Gaylord reached the plates the 21 lamps of her crown, banner and costume instantly flashed up and she stood clad in "nature's resplendent robe without whose vesting beauty all were wrapt in unessential gloom."

The dynamo which generated the current for the lamps was made by Mr. Gaylord three years ago, and he writes that it is automatic in action, and "the fact that the 21 lamps were put in circuit and were cut out by the raising of a heel plate from a floor plate and that there was no variation in the three lamps at the station, speaks well for the efficiency of so small a machine." That the costumes worn by the ladies at the carnival were exceedingly realistic may be judged from the following description taken from a local paper of a dress worn by the representative of the drug industry: "Dress cream colored, trimmed with sponges, brushes, combs. Necklace of 36 one dram bottles, each a different color; epaulets made of hair brushes; headwear of chamois skin trimmed in tooth brushes; banner, pink satin with gold fringe, 'City Drug Store' on one side and mortar and 'Patent Medicines, Drugs, Putty, Glass,' on the other in gold."

Duplex Rotary Engine.

The demand for small and compact high speed engines has materially increased since the introduction of electric lighting and electrical distribution of power. Designers have, therefore, of late been bending their energies toward the perfection of that ideal type of steam motor —the rotary engine. Among the types which have been recently brought out is the Duplex engine. This machine is now being manufactured under the patents of J. S. Kiehl, F. Meyer and A. Grant of Chicago, and is attracting considerable attention. The engine appears to be somewhat of a departure from the old and beaten paths, and undoubtedly possesses a number of features of interest. It may be well to state that the inventors describe the engine as in reality a piston engine, reversed, as it were, and constructed as a rotary engine.

In order to understand the construction and operation of the engine, it will be necessary to closely study Fig. 2. The general design is shown in Fig. 1. From the former it will be seen that the casing incloses a circular or wheel-shaped casting, in which there has been cut a slot or steam space. This casting is carried by the central or main shaft of the engine, and revolves within the outside casing with a small clearance, as shown. Projecting into the steam space, above referred to, which is indicated in the illustration by the absence of section lines, is an abutment *E*. This abutment is a part of the casing which was removed in the illustration in order to expose the inside of the engine. Within the space inclosed by the circular slot, into which the abutment projects, there is set a stationary cam. Attached to this cam are the four valves or gates, *F*, *F*, *F* and *F*. These are packed, as indicated, and move endwise in their slots as the relative positions of the cam and circular casting change. The steam inlet is at a point a little to the left of the abutment *E*, while the outlet for the exhaust is in a similar position on the right of the abutment. By moving the slide valve, shown at the top, steam may be admitted on either one side or the other of the abutment, and the direction, therefore, of rotation of the engine changed at will. This abutment *E* is packed, as shown, and admits of the revolution about it of the wheel casting, with but little friction. The joints between the sides of the casing and the revolving casting are made by a packing ring and sections of a ring set into the wheel-casting, one on each side of the slot.

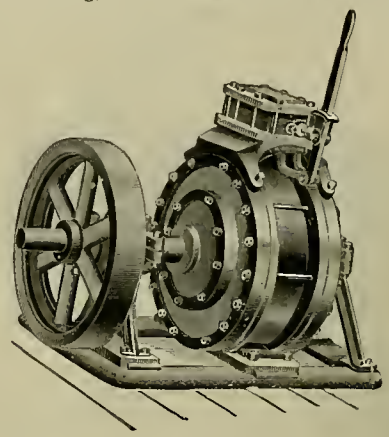


FIG. 1. DUPLEX ROTARY ENGINE.

This packing is arranged concentrically with the circular slot, and presses out against the lid, which is removed in the illustration. The operation of the engine is as follows: Assuming steam to enter through the casing to the left of the abutment, it forces the wheel around until the lower valve of the four, shown in the cut, is withdrawn by the change in the relative positions of the wheel and cam. This exhausts the steam. Meanwhile, however, that valve, which is represented to the left in the cut, has been pushed across the steam space and has closed it. The steam, therefore, now acts on this portion of the wheel, as it did on the other portion. In this manner the continuous rotary motion is produced.

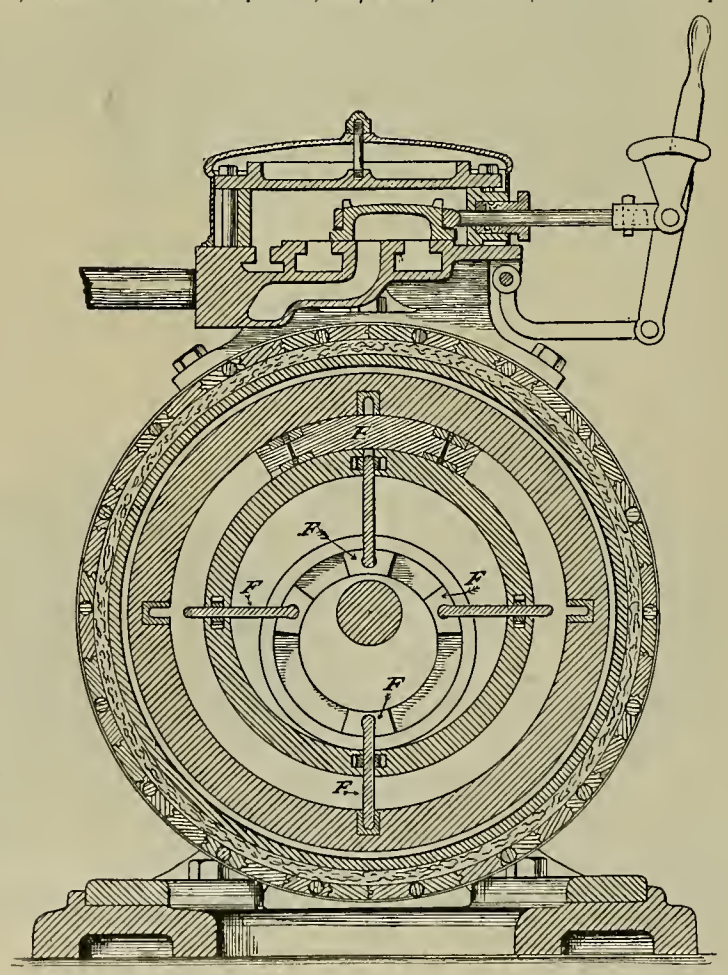


FIG. 2. DUPLEX ROTARY ENGINE

Dixon, Cal., claims the distinction of having the first Edison central station in that state.

Method of Measuring Alternating Currents.

Among the novel methods of measuring the alternating current, which have lately been proposed, may be mentioned one recently invented by W. Lowrie, C. J. Hall and H. W. Kolle of London, Eng. This method may be described as one in which the current is measured by differentiating the wave of potential, so to speak, so that there is a slight preponderance upon one side of the neutral line. In other words, the e. m. f. of the current impulses in

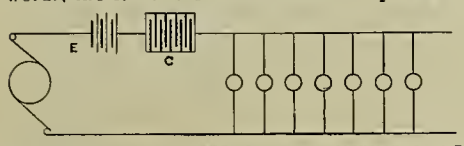


FIG. 1. METHOD OF MEASURING CURRENTS.

FIG. 2.

one direction is increased while the e. m. f. of the impulses in the opposite direction is retarded. This difference between the potentials, the inventors claim, is available and may be utilized for doing the work of measurement either by mechanical means or by chemical action.

It is well known that alternating currents as ordinarily applied will not deposit metal. But in the meter in which this method is to be put in practice, an alternating current of electricity is made to deposit copper as a measure of the amount of electric energy expended in the lamp circuit. The manner in which this is to be accomplished is explained as follows: Let it be required to measure the current consumed by a number of lamps on a lighting circuit. There is placed in the lamp circuit a voltaic cell which comprises two dissimilar metals placed in an acid solution. When an alternating current is passed through this cell and the lamp circuit, the flow of the current is alternately retarded or assisted by the normal electromotive force set up in the cell itself. This action causes a wasting of the positive electrode. As the resistance of the lamps on the circuit varies according to the number and kind used and the duration of the flow of current through the same, so does the current vary in the cell which acts upon the positive electrode. This current is directly proportional to the electromotive force of the cell and the resistance of the lamp circuit. The action of the cell therefore becomes available as a current measure. In illustration of the method the reader is referred to the two accompanying cuts. Fig. 1 shows a system arranged with a constant e. m. f. at *E* and a depositing cell in circuit at *C*. In this system, it is stated, the differential action of the current causes an electro-deposition of metal in the depositing cell *C* by the influence of the electromotive force in *E* on the alternating electromotive force. As the quantity of metal deposited is proportional to the amount of electricity passed through the lamps, it becomes a measure of the same.

In Fig. 2 the method is represented as applied to a converter system. The diagram represents the converters with their primary coils connected in the main circuit. The sources *E* and *E* of additional e. m. f. and the deposition cells *C* and *C* are inserted in the secondary wires as indicated.

Edison's Exhibit at the New York Women's Exchange.

Edison has contributed to his popularity in New York, if such a possibility be admitted, by his assistance in making the exhibit of the Women's Exchange, which was opened Monday, the most interesting display ever given in that city. The principal feature of this exhibit is the magnificent display of electrical machines and contrivances which Mr. Edison has loaned the Exchange for the occasion. These include all the devices which were displayed by Mr. Edison at the Paris Exhibition and are valued at $100,000. It is stated that in preparing this exhibit for the Women's Exchange Mr. Edison and his associates expended $25,000. Every afternoon a special performance of an electrical character is given. Fifteen electrical experts under E. W. Hammer perform fantastic tricks. They are placed in an electric column in the center of the hall. It is 25 feet high, 8 feet in diameter and dressed like a May-pole, adorned with natural flowers and greens, and 14 streamers of green are stretched from the top of it to as many points around the room. In addition to these streamers banks of potted plants and flowers hide the base of the tower from sight. The floral adornment of the tower, however, is really a minor feature. Five thousand electric lights in colored lamps are arranged in spirals from the base to the summit of the tower, and as many more are twined in the streamers, while from the top streams of colored lights are shot forth, so that even before the experts inside begin their performance, the tower is a thing of almost indescribable beauty. When these performances begin, however, the audience can readily imagine themselves in fairyland. The effects produced are indeed wonderful, and in splendor outrank anything ever seen in this country. A magic lantern of almost unimaginable power casts upon the ceiling from the top of the tower such pictures as seem to be the actual performances of living beings. From this tower as a center, wide aisles stretch out as diameters of the room, and in the segments are elegant mahogany tables, on which are some 500 of the marvelous machines that have made Edison's fame. At each table is a placard on which is printed a description of the machines on the table, telling their uses and the principles of their construction. For the student of electrical science there is a greater opportunity than was ever before presented in this country.

The machines on the floor below comprise an exhibition of the telephone and phonograph, and such unfamiliar things as the walking, talking dolls, the electric shoe-blacking machine, the marvelous contrivance whereby one can press a button and cook an omelet, and numerous other preposterous contrivances.

In addition to all these there is a most interesting exhibit of processes elaborated by Mr. Edison in the working of mines in North Carolina. One of the queerest tricks in throwing light, by the way, is that which is used to illuminate a beautiful piece of statuary loaned to the exhibition. This is Miss Lawson's "Birth of a Mermaid," which adorns the main corridor. It is placed so as to be in front of a dark background, while every outline of the sculpture is thrown out distinctly by a strong light, the source of which is invisible to the beholders. The effect is as if the statue itself radiated light.

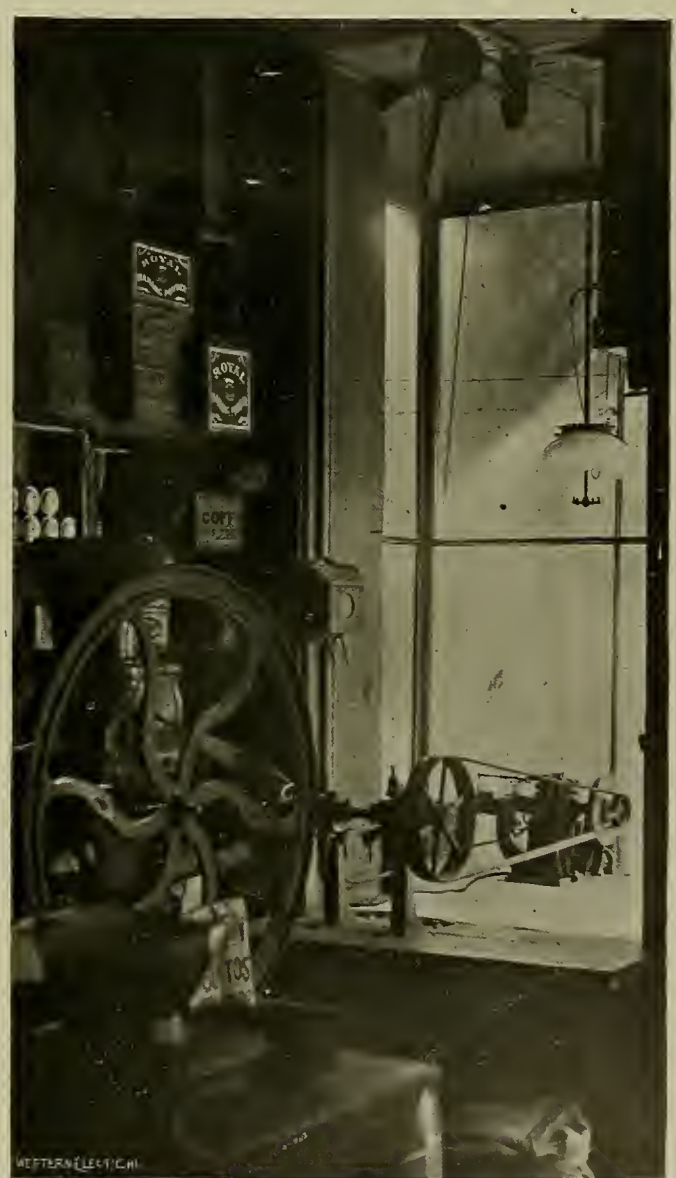
An electric street railway nearly fifteen miles long will be constructed during the summer, connecting Ogden, Utah, with the Great Salt Lake.

A Misplaced Space.

A misplaced space in a printed line often effects a curious change in a writer's meaning. A striking illustration of this fact was given by the compositor who set up a portion of Dr. Duncan's paper last week. The author mentioned the fact that a certain type of dynamo had been tested in *lighthouse work*. The statement apparently did not commend itself to the printer, for by transposing a space he made the author say that the machine had been tested in *light housework*. The sentence appeared correctly in the WESTERN ELECTRICIAN, thanks to the proof reader, and the machine was not made to do duty as a domestic one.

Arc Motor in a Grocery.

Those who believe arc light current to be deadly might, perhaps, wonder at their own unnecessary fears if they had happened to notice a 1-horse power Excelsior arc motor at T. Moran's coffee store on State street, Chicago. This little machine has been running in the window for about a year, and is supplied from an underground circuit of the Chicago Arc Light & Power company. It drives the coffee mill as shown, and also furnishes power, operating an advertising device in another window. Not only is it running on the arc light wires but it is within easy reach of the clerks in the store. In spite of this, however, no one gives himself the least concern about the machine; no one has been hurt—nor is likely to be. The motor furnishes a steady and constant power, the proprietor is pleased with his possession, and the employes understand that their business is to sell coffee—not to inspect motors. It is an excellent illustration of the safe utilization of the high tension current.



ARC MOTOR IN A GROCERY.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate and will be promptly furnished on application.

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NO DOUBT has ever been entertained by the electrical press that its efforts have contributed in a substantial measure to the marvelous development of electrical industries. Still it is pleasant to realize that this belief is shared by those who advertise in electrical newspapers. At a recent meeting of business men, a prominent electrical supply man made these remarks which are well worth reproducing: "It is the broad and liberal policy pursued by electrical journals that has done more than all else combined to build up the unparalleled prosperity of the electrical industries, and to place them in the front rank of commercial industries." Referring to his heavy advertising expenses, he said: "Of course it costs money to advertise, but for every dollar I have paid out I have received two, yes, sometimes ten-fold in return. . . . Liberal advertising not only stimulates purchasing, but also stimulates hesitating capitalists into making new investments that in turn benefit all."

IN the discussion which followed the reading of the paper entitled, "Some Tests of the Efficiency of Alternating Current Apparatus," which was presented recently at a meeting of the American Institute of Electrical Engineers, an interesting fact was related. Dr. Wheeler called attention to a curious electrical effect which he had observed in connection with alternating current lighting circuits. He stated that where in one instance two separate lines ran parallel among a number of others for about three miles, it had been noticed that a peculiar pumping or beating took place in the lamps on these particular lines. The pulsations of current which at first he thought were caused by irregular speed at the engine, were accounted for by the fact that alternations of current on the two circuits were nearly but not quite synchronous. In other words, he discovered that the lines referred to were strung in such a manner that they could act inductively on each other while the remaining lines were so placed that they could neutralize their own effects. A change in the relative position of the two sets of wires was found to be an efficient remedy. The detailed account of Dr. Wheeler's investigation will doubtless prove to be of interest to our readers, for a number have in all probability experienced a similar trouble.

IT is proposed to load an additional burden on the electrical manufacturing concerns of this country by placing a duty of 35 per cent. on all imported mica. This is the proposition of the McKinley tariff bill now pending before Congress, and unless the good sense of the members returns, there are strong reasons for believing the provision will become a law. Mica is used principally by stove manufacturers and electrical concerns, and in each of these industries it forms an important item. There are only a few unimportant mica mines in this country, in New Hampshire and North Carolina, and the product of these mines is of such an inferior quality that it cannot be used for electrical purposes. The home product is almost exclusively used by the stove makers, while the imported article is consumed by the manufacturers of electrical apparatus. There is absolutely no excuse for the imposition of this duty on mica. It cannot serve to divert the trade of electrical houses from its present channels. The inferiority of the American mica will make it necessary for electrical concerns to look elsewhere for their supply, and they will be compelled to import this article unless something else is discovered to take its place. Until the quality of the American product is greatly improved, it is evident the imposition of this duty on imported mica will not serve to increase the sales of the local concerns by turning the electrical trade to them. There is, therefore, no reason why mica should not remain on the free list.

THE daily press has lately been circulating a number of vague rumors in regard to an alleged proposed electric light trust. Financial writers, according to their own statement, have merely indulged their fancies in speculation concerning these indefinite reports. They have confessed their inability to state substantial facts. What basis there may be for these reports we know not. This much we do know. The formation of a successful electric light trust must be a matter of the gravest difficulty. Looking back over the events of the last few years one finds little encouragement for those who would form such a syndicate. The collapse of the carbon trust is a single illustration in point. The failure of the copper syndicate, formed to force all users of the metal, and pre-eminently electrical manufacturers, into paying more than a just price for its product, is an illustration of the difficulty attending such gigantic enterprises. In this case there were many reasons which naturally afforded the projectors grounds for belief in the ultimate success of their undertaking. They had almost unlimited capital. They simply had to obtain control of a metal, the world's production of which could be very fairly estimated. A great many incidental conditions conspired in their favor, such as customs duties; they had the assistance of shrewd financial lieutenants to aid them in their task at home and abroad, but still their carefully laid plans came to naught. The trust was a disastrous failure. The career of another syndicate in England is interesting in this connection. The English Salt union was organized under auspices apparently the most favorable, but it has by no means met with the success that those interested in it felt themselves warranted in confidently predicting. Prices were advanced, it is true, but the profits of the syndicate seem small when compared with the figures mentioned in the prospectus. A single company which remained outside of the trust has just declared a dividend three times as large as any which the stockholders of the union have any reason to expect. If such difficulties beset the projectors of enterprises whose object consists in merely controling nature's products, the supply of which is fixed by necessary conditions, how much more arduous will be the labors of those who attempt to form a trust whose purpose is to control prices of manufactured articles like electric light machinery. The patents held by any half dozen companies in the country are not so fundamental, we think, that their ownership would enable the possessor to prevent manufacture by other concerns. An electric light trust, therefore, formed to raise prices, would doubtless find that its organization had led to the formation of scores of small concerns whose competition could not be despised by a syndicate, no matter how gigantic. These remarks are not made to indicate our disbelief in the rumors, or to show that there is any inherent improbability in these indefinite reports, but merely to emphasize the statement that the organization of a great electric light trust is an undertaking involving tremendous difficulties, and the gravest risks. Stockholders of manufacturing companies now doing a successful business, may well hesitate before giving their assent to such a scheme. The precedents are not in favor of its success.

IN the last number of the *Century* Georges Berger, director-general of the Paris Exposition, considers the subject of "Suggestions for the next World's Fair." Mr. Berger's views are of especial interest to the electrical fraternity, inasmuch as upon him devolved the active management of the International Electrical Exhibition in 1881. Still, thinking of the glory of the exposition of 1889, Mr. Berger is inclined to believe that any date in the present century will be too early for the next World's Fair; the magnificence of the Paris Fair will tend to overshadow any exhibition which can be arranged in two or three years. Still he concedes that, perhaps, Americans can accomplish the stupendous task of preparing a successful fair in so short a time after the Paris Exposition. Mr. Berger's first suggestion is that the organizers of the fair shall aim at "novelty and the extraordinary," but "without neglecting due order and method." It has become a recognized fact, he says, that in international fairs, the "displays of ideas" should be considered as well as the material exhibitions. He says on this point: "The primary conception of such an organization of exhibitions came to me at the time when I was interested in 1881 with the direction of the International Electrical Exhibition held in the Palace of the Champs Elysees. It occurred to me that an exhibition of this nature could not fully attain the ends sought if it were so restricted as to appeal only to the eyes of the public—that is, if it were merely to display results to visitors in general, still ignorant of this newest branch of physical science, without giving them the means of appreciating some of the researches which had brought these results into being. Actuated by this reasoning, I induced the government to call together an International Congress of Electricians, for whom the exhibition became a masterful library, and the crowds of visitors to the exhibition manifested a redoubled interest in the apparatus, and the experiments displayed, when these were explained to them through the published accounts of the sittings of the congress, with all the prestige attending the foremost electrical authorities in the world." Mr. Berger, therefore, urges upon the Chicago World's Fair directors the necessity of considering the ideal and economic side of the next exposition as well as the mere material conception. Mr. Berger evidently would advise, though he does not say so in so many words, the organization of scientific congresses. He estimates that the cost of the exposition will be a little more than $17,000,000. He makes a number of practical suggestions, and incidentally says that the cost of electric lighting should be included in the estimate of running expenses.

Economy of Electric Railways.

An extract of a lecture delivered by Eugene Griffin at the Franklin Institute, Philadelphia, is appended. After speaking of the general mode of operating electric roads, he adverted to the economy of the electric system as follows:

Even were electricity as expensive as horse power, its numerous advantages would ultimately result in its general adoption, but as a matter of fact, it shows a very considerable saving over horse power. This is to be expected. If we have one source of power—one power station—instead of a thousand, we ought to generate the power at a less cost. If we have efficient motors and a well-constructed line, we should expect to utilize this power with little waste. Of 100 horse power produced in the steam engine, ninety-two is converted into electricity and goes out of the station over the line as electrical energy. The loss in the line need not exceed 10 per cent., though in some cases it may be economy to allow a larger loss. We thus have 82.8 horse power delivered to the motor on the car. If the commercial efficiency of the motors and gearing be 75 per cent., we have 62.1 per cent. horse power utilized in moving the car, or a total efficiency of 62.1 per cent. Of course, we may fall below this figure. The actual power required per car depends upon the grades, the speed, the curves, the kind and condition of track, the size and weight of the car, the average load, etc., conditions so variable that it is hopeless to try to determine any average figure. The power will range from 4 horse power to 9 horse power under ordinary conditions, and may increase very considerably under extraordinarily bad conditions. The cost of power at the station depends upon the kind and size of the engines, the price of coal, the management of the station, etc It ranges as low as nine-tenths of one cent. per car mile, and as high as seven cents per car mile. The latter is a very extreme case and does not represent the actual cost. This price is paid for power for a single car operated under the most disadvantageous conditions; this car, however, yields a better return to the railway company than any other car on its entire system. This indicates that a high price is not always incompatible with economical results. The cost of repairs depends very largely upon the care bestowed upon the apparatus, and any figures given without a full statement of all the special conditions would be misleading. I have known the cost of material for repairs on a large road to run as low as nine mills per car mile for one month, and I have known it to go very much higher.

Speed is not only an important factor in determining the value of electric railways to the public, but it is equally important to the railway manager as a source of economy. If we average six miles per hour with horses and nine miles per hour with electricity, it is evident that in the latter case one car does 50 per cent. more work with a corresponding saving in the item of wages of conductors and drivers.

In the crowded city streets we cannot hope to gain much speed In the suburbs the gain is only limited by considerations of safety. From Harvard Square, in Cambridge, to the end of the line, in Arlington, the electric cars average about eleven miles per hour, including stops—better time than is made by the elevated roads in New York city. On the Watervliet Road, between Albany and Troy, the following is the record of one month's work:

MILEAGE OF WATERVLIET CARS, DECEMBER, 1889.

Average number of cars in daily service	7¼
Total mil-age, thirty-one days	31,340
Average daily mileage	1,011
Average daily mileage, per car	139

On December 20, 1889, we have the following record of five cars:

	Miles.
Car No. 43 made a total of	180
" 44 " "	190
" 45 " "	190
" 40 " "	190
" 61 " "	180
Grand total	930
Average per car	186

On January 3, 1890, we have the following record of five cars:

	Miles.
Car No 40 made a total of	190
" 42 " "	190
" 44 " "	190
" 60 " "	180
" 62 " "	180
Grand total	930
Average per car	186

This is an imposition upon the motors. It is requiring more than we ask of the steam locomotive which runs under the most favorable conditions as to grades, curves and track. I give these figures as an instance of what can be done and what is done, not as an example of what should be done. We must be reasonable and not work the willing horse to death.

Increased speed is a great boon to the public, always clamoring for rapid transit. By the aid of electricity we have increased the average speed of the cars in Boston from six miles per hour to eight miles per hour, and were all the cars equipped electrically this increase alone would make an annual saving to the passengers of 4,152,000 hours or about 474 years Think of this as one year's saving in one city resulting from the use of electricity as a motive power for street cars. As a matter of fact, the gain in speed will be greater when all the cars are equipped, as the average is now kept down by the horse cars holding back the electric cars running on the same tracks.

The increased speed should not be lost sight of in comparing the cost of operating electric, with the cost of operating horse cars. A comparison on the basis of car days is not a just one. The comparison should be made on the basis of car miles. On the Watervliet road the daily mileage per car has been nearly doubled by the use of electricity.

Another economical feature of the use of electricity is the ability to haul one or even two tow cars. We can double or even treble our carrying capacity in case of emergency; and the extra plant kept for such purposes is in the cheapest form, representing a comparatively small invested capital, and subject to but little deterioration. Compare this with the cost of keeping extra horses sufficient to double or treble our carrying capacity. The difference is enormous.

On those roads or lines where the traffic is great and constant, we will have larger cars. By using the radial truck or double trucks, we can handle 30-foot cars as easily as our present standard form, and do away with the annoying and destructive teetering inseparable from a long car mounted on a 6-foot truck. We can nearly double the seating capacity, and still use but one conductor and one driver.

From the foregoing, it is evident that electricity admits of many economical changes, and that, in many ways, we may hope to reduce expenses by its use, at the same time giving better service. What we must look to, of course, is the ultimate commercial result. Whatever may be said pro and con, the commercial result must be the final criterion. We are now receiving some light in this direction from the annual reports of the roads in those states where the statutes require such reports. Such statistics are of great value, for whatever difference may exist as to classification and arrangement, the total expenses and the total receipts are bound to appear in some form or other. From the reports of the Railroad Commissioners of New York and Massachusetts for the year 1889, we extract the following:

EXPENSES OF STREET RAILWAYS, NEW YORK STATE, 1889.

Horse Roads.—Average proportion of receipts to operating expenses, thirty-three roads, 79.39 per cent

Electric Roads.—Average proportion of receipts to operating expenses, two roads, 53.50 per cent.

EXPENSES OF STREET RAILWAYS, MASSACHUSETTS, 1889.

Horse Roads.—Average proportion of receipts to operating expenses, thirty roads, 82.87 per cent.

Electric Roads.—Average proportion of receipts to operating expenses, two roads, 55.50 per cent.

In 1888, the gross earnings and operating expenses of surface and elevated roads in three states were as follows:

RECEIPTS AND EXPENSES PER PASSENGER, 1888.

	Gross Earnings.	Operating Expenses.	Net Earnings.
	Cents.	Cents.	Cents.
Elevated Roads—New York State	5.01	2.81	2.20
Surface Roads—New York State	4 94	4 02	.92
Third Ward Electric Railway, —Syracuse (1889.)	4.92	2.78	2.14
Surface Roads--Pennsylvania	5.59	3.18	2.41
Surface Roads—Massachusetts	5.10	4.28	.82
Boston and Revere Electric Railway (1889)	4.70	2 71	1.99

The column of operating expenses contains some very significant figures.

Such figures are more convincing than any labored argument. In time, as we have more of these reports, the skeptical will become convinced, and the doubting will be satisfied.

FIRST COST.

If electricity does all that is claimed for it, then it is a necessity in street railway work If the railway president investigates and finds that the claims are well supported, that electricity is safe, is economical, is durable and is reliable, then he seeks to know the cost A really good article is expensive. Electric motors are good articles.

The cost of equipment for a first-class double track road, including iron poles (side suspension), fifty-six pound girder rail, one 16-foot closed car and one open tow car to each mile of track, suitable generator and steam plant capacity, etc., would be approximately as follows:

PER MILE OF TRACK.

One mile of track (paved street)	$10,000
One motor and one open tow car, generator and station equipments, line construction, including poles and steam plant	10,000
	$20,000

A double track road ten miles long would cost on this basis $400,000, including twenty motor cars and twenty tow cars.

On a road with very bad grades, greater power might be required. If wooden poles be used, the cost of the line would be very materially reduced.

And now a few words as to the future of electric railways. The success of electrical propulsion has been established beyond question. It is only a matter of time, and that a short time, when it will replace the horses on the majority of our street railways. It is only a matter of time, a somewhat longer time, perhaps when it will be the propelling power on all our elevated roads, for the elevated roads possess ideal conditions for the application of electricity. It is within the bounds of possibility that our steam roads will be run with electricity; certainly this power offers many advantages for the suburban traffic in the vicinity of the large cities. The possible utilization of hitherto neglected water powers will be one of the factors in determining the extension of electrical propulsion in this direction. Already we see the beginning. The West End company of Boston, are building longer cars with radial and double-swiveled trucks. The New York elevated roads are anxiously seeking a solution to the problem of how to enlarge their carrying capacity without rebuilding or materially altering their superstructures. Longer trains are requisite to meet the increased demands. The limit of the capacity of the present locomotives has been reached Increased weight in the locomotive means an immense expenditure for strengthening or practically rebuilding the roadway. Cables are not feasible, as the strain on the grip would not permit of long trains, and it would be difficult to combine speed and safety with any considerable increase in the number of trains. Cables would not permit of satisfactory switching arrangements at the termini and elsewhere. Electricity offers the best solution. Equip each car with motors. Flexible electrical connections can easily be made from car to car as is now done on surface roads to light the tow cars, and the whole train controlled by the driver on the front platform of the leading car. Electric, vacuum, or air brakes can be used in the same way. It matters not how many cars we have in a train—one or fifty. Each car adds its own power, and all work together. There is no dead weight to pull, as in the case of the locomotive. The passengers themselves furnish the weight for traction. The switching arrangements present no difficulties whatever. The motors can be reversed and run equally well in either direction. The train can be controlled from either end and any increase or decrease in the number of cars will not affect the controlling mechanism.

It is difficult to conceive of a more flexible system. It seems to be the ideal system for the elevated roads, and is bound to be adopted in the near future.

Some Tests of the Efficiency of Alternating Current Apparatus.

In the last issue of the WESTERN ELECTRICIAN was presented a paper by Dr. Louis Duncan and W. F. C. Hasson entitled, "Some Tests of the Efficiency of Alternating Current Apparatus." The paper was presented at the meeting of the American Institute of Electrical Engineers. After the reading the following discussion took place:

NIKOLA TESLA: Dr. Duncan has brought forward some facts which have not been recognized before, for instance, the fact that the loss in the iron of the converter remains perfectly constant with varying loads. That has not heretofore been acknowledged or known so far as I have heard. But, on the other hand, when we consider the action of the converter, I think it ought to be. In converters in which the primary and secondary are put in the closest possible relation, for instance in the Westinghouse, the increase of the primary and secondary is in an almost constant ratio, and since the loss in the iron is due to something like a difference in action of both currents I think the loss of the iron ought to be constant within certain limits.

With regard to the excessive loss in the dynamo machines, I may say this: In the armature that Dr. Duncan has found, I think that most of us know that this loss is not due to the fact that we must have that loss, but because we must sacrifice a certain amount for the regulation of the machine. Now, the same machine that Dr. Duncan has tested, any one of us could cause to give a greater output and with a loss in the armature of no more than one or two horse power. But we must work with a highly saturated field in order to obtain a constant potential on the converters. On the other hand, the comparison between the single circuit, alternating current and the direct current machine is just, and the proportions I believe are substantially as Dr. Duncan found them; that is, if we compare a single circuit alternating machine with a direct current machine we will find, representing the output of the latter by a number say 100, that the alternate current machine with one circuit will give for the same speed and weight about 78 or perhaps less. But we must also consider that we are enabled with alternating current machines to work at a very much higher speed and the simplicity of the apparatus allows us to work at a very much higher electromotive force. On the other hand, if we operated an alternating machine with two circuits, then the output of the machine will no longer be inferior to the direct current machine, but it will equal it if not be greater. I believe that Prof. Anthony some time ago told me that he also found that the loss in the armature by higher field saturation increased more rapidly than we would generally suppose. I have also found if the field of a large generator is saturated very highly we may by only a few revolutions in a few minutes heat the armature so that the wires will burn out. I think the losses in the armature increase very greatly with the saturation of the field. Now, as regards the general results obtained by Dr. Duncan, I am firmly convinced of their correctness, of course, but I also firmly believe that Dr. Duncan has not had the best converter in hand. For I have myself made tests, and others have made tests, where the efficiency of such converters is shown to be much higher than is shown by Dr. Duncan. With the improvements we have made lately I believe that the new converters have now reached a much higher efficiency.

H. WARD LEONARD: We had some theoretical discussion relative to comparative efficiency of the continuous and alternating currents at Chicago a couple of years ago. At that time we had very little beside theory to work on, especially in respect to results in the alternating field But I was a little interested in looking over the figures which at that time were arrived at theoretically and comparing them with those which have been obtained. The claim for the continuous current efficiency which was made there was based on a maximum loss of twenty volts in a three-wire system, on each side, that is 15 per cent; and the average load was considered 40 per cent. Therefore the average loss in the conductors was considered 6 per cent. for twenty-four hours, that is an average efficiency of 94 per cent. The total efficiency of the continuous current system was found to be 84.7 with the generators operated at full load, as they would be in such a system, such generators as were not needed being cut off and assuming an efficiency for the conductor of 94 for the feeders, 1 per cent. average loss in the mains, 1 per cent. average loss in the service and inside wiring. With the alternating current system the lowest efficiency that was assumed was 85 per cent.; the efficiency of the generator was claimed to

be 98 per cent., of the feeder, 90 per cent., of the converter, 99 per cent., of the services and inside wiring, which gave for the total efficiency 74 per cent. I was not fortunate enough to hear the actual efficiency which the present three-wire system showed; but I remember that the professor gave the efficiency of the alternating as 61 instead of 74. I think that a point which is perhaps the most pertinent and which has been pretty well emphasized of late, is the fact that the average load of a system of lighting generally through a city is a very small percentage of the connected devices. I know of one instance where the lighting will be ultimately much greater than at present, but yet the average load for twenty-four hours is only about 12 per cent. of the connected load. This, of course, brings into prominence the question of the efficiency of devices under conditions of light load. In the case that I mentioned the maximum load is 30 per cent. of the connected devices, and the average load is 40 per cent. of that maximum

DR. WHEELER: Although I may not be able to add anything to the subject of converters, I might say something about the effect of alternating currents with parallel wires. I know of a case in this city where lines ran parallel for about three miles, and where the current jumped up and down continuously, causing the lights to beat just as if they were driven by a steam engine which did not have a heavy enough fly wheel. After a very extensive investigation, it was found that the jumping of the lights was due to the fact that alternations on two circuits were nearly but not quite synchronous. When one set of waves caught up with the set of waves on the next wire while passing them, it first drove those waves ahead and then drove them back. This caused the energy of one circuit to first pile up the energy in the other circuit and then force it down and thus cause a pumping effect on the lights. That was overcome entirely by placing the wires in pairs properly. That is to say, the two legs of each circuit had not been arranged side by side. One or two of the circuits had been misplaced. But by bringing those together, so that the negative side or leg of one circuit was right alongside of the other leg of its own circuit and not mixed up with the wires of any other circuit, the induction was completely neutralized, and that left the lights perfectly steady. The company had been very much troubled to know what the cause was. I had been formerly driving Edison dynamos with high speed engines and I laughed at the people who were running the lights, assuming that their fly wheel was not heavy enough. They suggested that I should try the fly wheel. I made them buy a very expensive speed indicator and put it on, and about as soon as they got it running I made up my mind that the inertia of the indicator mechanism would be too great to allow it to respond quickly enough, that is to say, if the steam engine made about 74 revolutions a minute, as it did, and if its speed varied enough to show a flickering in the light which would be about 2 per cent. variation in the middle of each stroke of the engine, it would not be easy to get a speed indicator needle which would show such brief, rapid and small variations as 2 per cent. variation on every stroke—that is, in less than one second for each. I then tried figuring out the weight of the fly wheel to determine how much speed ought to increase or decrease between the strokes. Assuming the fly wheel weighed thirty tons and had a diameter of thirty feet; that 500 horse power was being drawn off by the belt continuously and was being put into the fly wheel twice in every stroke by a brief impulse of the pitman with no source of power in the intervals, how much would the wheel slow down in the seventy-fourth of a second? In other words, how much would 500 horse power slow down a thirty-ton fly wheel of thirty feet in diameter in the seventy-fourth of a second. About that time I made up my mind that this would be a long matter to figure out, I decided to try the plan of a substitution, that is, to change all the elements of the system one after the other until I found to which element—for example the dynamo, the lines or the engine—the trouble was due. We therefore tried driving the different dynamos by different engines and connecting different lines on different dynamos. We then found that the trouble went with a particular wire. That surprised me. I counted the number of pulsations in the lights, and found that they were about eighty to the minute. I had inspections made and found that there were only two parts of the city where the lights pumped in this way. I compared the pulsations of the other set of lights and found they also were eighty to the minute. I then concluded there must be some reaction between the lines supplying the two districts. Following the wires out, I found that the two sets of wires that supplied these two groups of light were placed in a position where they could act inductively on each other while the remaining lines were so placed that they could neutralize their own effects. I suggested that one set of wires be changed. This was done and there was no more pumping. It was clearly due to one set of alternations "beating" with the set on the other wire.

MR. TESLA: Dr. Duncan mentions the point that the construction of the converters would be modified when their size increased. I had hoped that Dr. Duncan, whose work in that line has always been so valuable, would give us some points on that. It is evident to every one that it is impracticable to increase the size of the converter in the same proportion as its capacity is increased, because as we operate the converters at a constant number of periods, we would render a long magnetic circuit transformer very inefficient. A plan was proposed by me a year or so ago to introduce in the construction of converters the same length of magnetic circuit, no matter whether the converters were large or small. I believe that this would be the proper way of constructing all converters on one system, and I believe that the present method of constructing converters is incorrect, for every different capacity of converter has a different length of magnetic circuit, and we know well if one converter is adapted to, say 16,000 reversals, another one with a different length of magnetic circuit is not adapted to the same number of reversals. We started a year ago, I think, to make all converters of the same length of magnetic circuit, so as to render them equally adaptable for the same number of alternations, no matter what their capacity is, and in such case, if we want, for instance, a converter that has ten times the capacity of a small twenty-light converter we will practically put in one converter so many multiple circuits as are required to get the capacity required. We will allow a somewhat greater capacity to maintain the converters all at the same temperature. I believe that this plan should be followed. In general, I may say that the results obtained by Dr. Duncan refer to an apparatus considerable time in use, but the advances that have been made in that line, even in the last year, are so enormous that we would not recognize this plant at all. For instance, I believe that the converters at present can be made to have less than half the leakage that they had previously. In other words, it means practically, a converter can be run with a double load—the machines are increased very nearly to double their capacity; and when we consider the short interval in which this has been accomplished, we may fairly assume that in a few years hence there will be little difference between the alternating and direct current, even on short distances.

DR. DUNCAN: In respect to the construction of converters of course, in increasing the dimensions in the same proportion, I was not following out the proper design for every given converter. Every converter has its own proper dimension, and all dimensions do not increase in the same ratio. But I think that Mr. Tesla's idea of keeping the same length of the magnetic circuit is hardly proper. I have worked out for my own amusement the design of a number of converters, and I think that the same period should be retained in the circuit, and a converter should be designed which would give the maximum possible efficiency. For a converter of given capacity as far as I can make out, you must have a definite period. There is a definite period, which, with the given proportions of iron and copper, correspond to the given capacity of the converter, but if you simply increase the cross-section of the iron without increasing the length of the circuit you keep the same cross-section of copper, which is not a good practice. You have to change both the cooper and iron and I did not think it would be very interesting to design a large number of converters for any given output. As for the efficiency of this plant which was tested, the plant was sent on, I think, in November, and was supposed to be the latest plant which was produced by the Westinghouse company. I have since heard that the efficiency of converters has been greatly increased. The losses in the converters could undoubtedly be greatly decreased, especially for larger sizes. As to the relative efficiency of the two plants, it must be remembered that I have simply taken a 750 light plant, and one dynamo is supposed to be always connected with the circuit in a station of ordinary capacity, that is of more than twice 750 lamps. We would certainly have the advantage of having at least two dynamos, one of which could be disconnected when the load had reached its minimum and the efficiency therefore would be greatly increased; and also in comparing the efficiency of alternating and continuous plants, we must remember that the business that is catered to by these two plants is very different; that the load diagram of the alternating plant is very different from the load diagram of the continuous current plant. There is a great discrepancy between the curves and the figures of the two. An alternating plant takes up the cream of the business, so to speak. It takes up business in which the maximum output for a given number of lamps wired is obtained, and in that way we must not calculate the efficiency of the alternating and continuous current plants in order to compare them. If so, we are favoring the continuous plant very much. With the alternating current plant it is simply a commercial question. If you can put into a continuous current station an alternating plant which will get business that will pay you, it is undoubtedly proper to put that plant in. In the same way if you have an alternating plant and it is so situated that you can run more economically with a continuous current plant, then put in a continuous current plant. But as the business stands at present, a combination of the two plants is undoubtedly theoretically the most efficient.

O. T. CROSBY: I should like to ask if the advances reported are in the direction of increasing the efficiency of the converter at all loads, or only at some normal loads?

MR. TESLA: I said before that the leakage was reduced to one-half, and I thought it was clear enough that that applied as well to the working of the converters on the full load as on the small load. When I speak of leakage I mean no load at all. But Dr. Duncan said just now—I thought he misunderstood me in regard to the construction of these converters—I proposed not to keep the length the same and vary the section, but simply to vary the section of the copper, at the same time varying the section of the iron. We have plates, for instance, which contain so many multiple circuits. These plates are so made that the coils can be just as well put in as one single circuit transformer, a form of construction invented by Albert Schmidt of the Westinghouse company. In this way we have practically a number of independent transformers and the only diminution of the capacity of such transformers is that we have a somewhat smaller surface. Then we may allow a little higher capacity for that diminished surface.

FREDERICK DARLINGTON: There is one thing which I think merits attention in the discussion of this question, that is, that one system uses the 50 volt lamp and the other system is forced to use a 100 or 110 volt lamp, and that by the same skill of construction of lamps and the same advance in the art of manufacturing lamps, the 50 volt lamps represent about 20 per cent. more efficiency upon the 100 volt lamps. That is found in practice. For instance, the 100 volt lamps which are being supplied now by one of the large commercial manufacturers of lamps are six-tenths or a fraction over six-tenths of an ampere, and 100 volts; while the manufacturers of 50 volt lamps make a 50 watt lamp and get 50 volts out of the lamp and a better service for the time. I can state that the United States Illuminating company of New York are getting out of the total amount of lamps wired on a circuit five and eight-tenths hours per lamp, which is about 23 per cent. All those points I think if taken into account, will make the efficiency of the alternating current come much higher than would appear at first thought.

MR. TESLA: Another point of great importance is the fact that in the alternating system you have apparatus of almost ideal simplicity. If the armature burns out it is a matter of a few hours' work to remedy the defect and the repair costs very little. If any part of the apparatus gives out it is easily replaced without trouble. With a direct current system I think on the average out of 100 armatures, if you take them on a year's run, there will be about fifty that will have some trouble or other. The commutator will wear out in a few years, even with the best attention—I speak of course of the average.

LIEUTENANT JOHN MILLIS: I believe in all the alternating systems that are now in practical operation in this country the rapidity of alternations, that is, the number per second, is practically the same. I would like to inquire what are the considerations which have determined this rate of alternations, whether they are mechanical or electrical. Will Dr. Duncan briefly explain to us what they are, also what the effect would be if the rapidity of alternations were varied. He touched lightly upon the theory of the effect that would be produced in the output or efficiency of the converter if the rapidity of alternations varied. I would like to ask if this theory has been confirmed by him, or to his knowledge by any one by practical experiment, and what the result of the experiment is?

DR. DUNCAN: By the English system I think the rate of alternation is determined very greatly by the size of the unit in which the distribution is made. For large units a low rate is commonly employed. You will find in most of the Continental and English systems that the rate of alternations has been decreased as the size of the converter has been increased. For a large converter a comparatively low rate should be used, as in this country small converters have generally been employed; the rate is very much greater than where the converter has been large.

TOWNSEND WOLCOTT: Dr. Duncan referred to Prof. Ryan's paper, and his idea in regard to diminishing the energy absorbed by hysteresis by vibrating the iron. Mr. Kennelly seemed to have the same idea as Prof. Ryan that you could get rid of the waste of energy very largely. The diagram of the hysteresis for one period as drawn by several experiments is as shown in Fig. 11 of Prof. Ryan's paper, one point at the bottom and the other at the top. Now, if you can come back by the same path as you go, of course the energy is zero. But Mr. Swinburne divides time hysteresis and ordinary hysteresis. Previous to the presentation of Prof. Ryan's paper I had the impression that the whole hysteresis worked in the manner which Mr. Swinburne calls viscous hysteresis; that is, like friction, it would resist in both directions. Mr. Swinburne's idea seems to be that the energy absorbed depends to a great extent upon the difference of phase between the magnetism in the iron and the magnetizing force of the current.

DR. MICHAEL I. PUPIN: I would like to ask Dr. Duncan whether he knows of any experiments that have been made lately for the purpose of finding out how much of the lost energy is due to eddy currents and how much to magnetic hysteresis. As far as I am aware, there has been no experimental work of that kind done, and that has been spoken of as a work which it is very desirable to do—to determine the ratio between the two. I think that would also give us a means of testing whether work lost on account of magnetic hysteresis is the same for every period—whether the same current is obtained as shown in the diagram referred to by Mr. Wolcott.

DR. DUNCAN: I am not prepared to give any figure on that, because I am experimenting on it at the present time. I am working now to weed out the eddy currents and to determine the effect of hysteresis for different periods of reversal. There is no data at present to tell whether the loss on the iron is due to viscous or static hysteresis. If we go through that change in magnetic force at a very low speed then hysteresis due to time hysteresis will not come in at all. If we go at the present speed it will come in. As I say at present my work is in trying to weed out the eddy currents. But I have not reached any results; and it is not a part of the paper. It is a very important question, though.

MR. LEONARD: I take the liberty of speaking for a second on the question of a five hour load. In New York City, which of course is the most exceptional in the other direction, the Edison station here has instead of five, nearer eight hours' average load which, however, may be somewhat due to the advantages derived from the sale of motive power

JUSTUS B. ENTZ: I would like to inquire if the losses due to eddy currents and hysteresis could not be determined by different thicknesses of disks. By taking two readings and separating them, I think it could be determined—the loss due to the eddy currents, of course varying as the electromotive force. If the thickness of the disk is doubled the potential is doubled, while the resistance making a watt load in each disk, varied as the cube, and if the disk in the converter were double in thickness and the same amount of iron, and the loss measured in the two cases, I should think they could be separated.

MR. TESLA: I should think that if hysteresis is a distinct element in the loss of the converter it can be only so because it is intimately connected with the generation of the currents in the iron. We cannot go beyond a certain thickness of the iron—say numbers 38 or 40, which may be yet thick enough to give rise to the currents in the iron. But the results that Dr. Duncan has to-day brought out strengthened me in the idea which I always had, that ultimately the whole loss in the iron resolves itself into the loss due to the currents. The facts he finds show that the principal loss is due to the eddy currents. The loss in the iron is constant at all loads; on the other hand, he finds that the loss is proportioned to the square of the electromotive force, which would be precisely the case if the loss in

the iron were due to eddy currents. I think that is an argument for this view.

DR. DUNCAN: As to distinguishing between the hysteresis and eddy currents with different thicknesses of plate, unfortunately Ewing has found that as far as this time hysteresis is concerned, it depends on the thickness of the plate independent of the eddy current. So, it would be impossible to distinguish in that way.

Storage Batteries to the Rescue.[1]

BY J. K. PUMPELLY.

Electricians and builders of dynamos, that seem to hold electricity in check, and deliver it harnessed for work, may ask nothing more; but the man who pays the bills for its use, the householder, who must keep up this constant motion in his engine, who watches the constant burning of coal under the boilers, asks for some relief. To the engineer, who watches hour after hour, day and night, its unvarying speed, so necessary to its perfect work, to the stoker, who hangs over the fire for many hours, feeling sure that if he fails in his special duty for a moment, the steam pressure will drop, the piston move slower in the engine, and the armature, that soul of the dynamo, lag in its speed, and this electrical horse, so well harnessed, feeling no longer the spur, falls back in his traces; to these now the storage battery steps in as a "rescue." And why? Because it can store up this restive power.

No fair-minded man will deny the benefits derived from securing the assistance of such an ally when current is to be maintained constantly night and day. By its aid many difficulties are avoided, and in many instances great economy is effected. It is unnecessary to say to you what the general public may not so well understand, that to keep the electric light constant for twenty-four hours without employing storage batteries necessitates constant motion, constant care, constant expense for coal, and relays of men in charge of the engine and dynamo. It is still better known to you, but not at all to the general public, that the motion of a dynamo must be maintained constant, whether it is carrying its maximum load or a much smaller load. Steam must be kept at a certain pressure, but the reduced consumption of coal is hardly perceptible. Of course, we know that to-day such improvements have been made in the self-regulating dynamo that it can adjust itself to the load, but still the reduction in the amount of coal burned can only be estimated at the end of a year's run when the machinery is under the control of experienced engineer and economical fireman. The "rescue" here is found in the fact that the current generated by a dynamo but not needed for lamps, can be passed through a set of accumulators and there create that potential energy which, lying dormant until needed, gives back a goodly percentage of efficiency. The energy which is thus used for charging cells might have been wasted in producing heat in a resistance coil. But the prevention of that waste of electrical energy is not the only advantage. The energy is returned in a most convenient form. This accomplishment, the saving of money, must be regarded as one of the most scientific of all accomplishments in this age. An old and wise saying, dinned into our unwilling years, whenever we were inclined to break into the little saving box, was—"Money saved is money earned."

Thus far we have referred only to the work the dynamo has to do in maintaining lights. But to-day there is another vast and increasing source of revenue made possible by the dynamo. I refer to the electrical distribution of power in which work the storage battery is a great aid. The electric motor, which drives machinery situated many thousand feet and even several miles from the source of energy, would often increase the profits of its owner if it could be made to continue its work when it would hardly pay to keep up steam and retain experienced labor over hours, as overtime is always expensive. Here is an opportunity for the accumulator to come to the rescue. Here, too, is found a use for smaller dynamos which otherwise would not be employed. A factory or machine shop, perhaps, has power to spare during the day. A pulley on some engine running with light load can do extra work without increasing the consumption of coal in any appreciable degree. That machinery shuts down at 6 P. M. The fireman, engineer and the majority of the workmen go home; but a contract has been made to deliver work at a certain date, and time is pressing. The contract is not large enough or there is not money enough in it to warrant the operation of the engine after hours, involving extra pay for night firemen. The storage battery stands ready to furnish the necessary power. The engine that would otherwise have been running uneconomically all day doing light work, calling for scarcely half its capacity, has been put to its full duty, and we all know that both engine and dynamo do their best duty when performing their full work. The little 10-horse or 4-horse dynamo, as the case may be, has been kept running, generating electricity which has been stored up.

When steam is shut off at 6 o'clock, the turner or the driller whose extra work only is needed to complete the contract is now enabled to continue his work by means of power derived from the storage batteries, which also provide for him the light of noonday to aid him in his work. So in the illustration which I have cited the contract is saved merely at an expenditure of a small amount for the overtime of a single employe. No large engine with fireman and engineer is required.

Again, suppose it is desirable to run cars on city streets where overhead wires are not allowed, or in some mine where the wires cannot be sufficiently protected from the constant dampness and drippings. Does not the storage battery afford a solution of the problem? The thousands of dollars which the wires would cost are saved, the engine and dynamo may be operated in some convenient and economical location, and there the batteries may be charged.

I have no doubt that every electrician and dynamo maker will concede the force of every point I have made, if it is assumed the storage battery is to be depended upon. Bitter experience perhaps has caused many doubts to arise. You have hoped for the aid which the storage battery should afford, but you have been disappointed. The batteries heretofore tried have demonstrated merely how advantageous a true storage battery would be by accomplishing everything claimed, but for a few weeks only. These facts must be admitted. Our disappointment is mutual; you who need this accessory, and we who make the batteries.

The fault, like the fault of all mechanism, for the conservation of power, is want of durability, when the action is constant and under a great strain. We know little of the tension of a current of electricity, forced by a dynamo through the elements of a secondary battery, or of its effect upon metals, when, if hypothesis is true, all the atoms that compose the metal are being constantly torn apart and reunited. Still we have learned, by costly experience, that some metals withstand this action more permanently than others. To-day, we have a better knowledge of the metals which can be used to the best advantage in a storage battery; we know how to avoid the failure resulting from disintegration. But time is necessary to convince capital that the storage battery which has been a failure heretofore, is no longer a failure.

When it was first announced, five or six years ago, that electricity could be caged, stored and sent away to a distance in boxes, people went wild about it, and even scientific men took it for granted that most wonderful and even impossible things could be accomplished by means of this stored energy, great expectations, far beyond the possibility of accomplishment by the laws of nature were entertained. Money was wasted in trying to accomplish the impossible.

But sober sense returned and knowledge came at last. I trust we share in that knowledge; we at least realize that the energy which a battery will yield cannot be greater than that which was stored.

A coiled spring and compressed air both tend to return to normal conditions. As the normal condition is approached the capacity of the spring, and the compressed air to accomplish work, decreases. It is the same with the elements of a storage battery. In some mysterious way, not yet understood, it reaches by means of a current of electricity, a condition of great compression. A moment is reached when the energy in the battery is equal to the energy which forces its atoms out of their natural condition. It begins to return to the normal. It is like a ball shot into the air; when the attraction of gravity has at last been overcome the ball begins to turn toward the earth, and falls faster and faster as it nears the ground, and at last rests quietly in its natural position.

What we have learned about batteries is, that the work we get out of them is in the fall. When first charged we have energy, or electromotive force enough to force a current of many amperes, through a long resistance coil, producing energy for light, or for motive power. Afterward, and at time now well known, this energy grows less and less, and does less and less work just as in the case of the uncoiling watch spring. In the action of the watch spring, an adjusting piece of mechanism is used to equalize this effect, like the escapement lever. We have learned to accomplish this with storage batteries, both in lighting plants and driving motors for street cars. The more perfect the mechanism for adjusting the fall of potential by turning in fresh energy to aid it at the proper moment, the more successful will be the storage battery. We can protect the material of which the elements are composed automatically, without reducing its efficiency, if we refrain from forcing it to do more than the work expected of it. If the battery is intended to drive a car which calls for ten horse power, don't expect it to operate a set of gearing for which, on account of the friction, fifteen horse power is needed. Don't say in the latter case that the battery exhausts itself too soon, merely running a ten horse power car, when the fact is, the battery has been called upon to do a constant work of fifteen horse power.

We believe in the storage battery. It has come to stay. The many ways in which it has proved its usefulness, I have not pretended to mention. Let, for one, the phonograph speak for it. The hum of machinery in many places where the dynamo could not go, speaks of its immense utility in performing a portion of the world's work.

[1] Read before the Chicago Electric club, April 7, 1890.

Electric Motive Power in St. Louis.

At a recent meeting of the St. Louis city council, seven bills providing for introducing electricity as a means of propulsion on street railway lines, were adopted. The ordinance granting a franchise to the Vandeventer line was ordered to an engrossment which is equal to an approval. This is an extension of the Lindell railway, of which it is practically a branch. Among the other bills favorably passed upon were the following: The Lindell Railway bill; the Benton-Bellefontaine Railway bill; the Forest Park and Laclede Avenue Railway bill; the Missouri Railway bill; the Mound City Railway bill; and the Union Depot Railway bill, all being applications for a change of motive power to electricity. The Broadway Street Railway bill was laid over, and will probably be passed at the next meeting.

The Central High School of Pittsburg, Pa., has been presented a 500 light electric plant. The Westinghouse Electric company recently made the proffer of the plant to the Central Board of Education, and this body immediately took the matter under consideration. A decision was speedily arrived at and the company received a formal acceptance of the gift, with a vote of thanks from the board. The Westinghouse company gives the high school a 500 light dynamo. Two hundred incandescent lights are sufficient to light the school with plenty to spare, and the operation of the plant will cost much less than the price paid for the present illumination.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 5.—The question of awarding the contract for subways was again called up before the Board of Electrical Control this week. Commissioner Gilroy, of the Public Works department, protested anew against the tearing up of the street after new pavements are laid, which the delay in awarding the contract seems to threaten. "If this is permitted," he said, "the money spent for paving will be wasted, for there is scarcely a street in the city exempt from the proposed operations of the electric light companies. I have contracts for $1,000,000 worth of pavements ready to give out, besides others for $400 000 worth to be laid by the authority of the Board of Aldermen." On Thursday the General Term entered an order reversing Judge Andrews' decision in the injunction proceedings against the mayor and Board of Electrical Control. This order will have the effect of preventing the execution of a contract with the Standard Electrical Subway company until the necessary amendments have been made. As amended the contract, among other considerations, should require the Subway company to erect, equip and maintain subways, other than those constructed or to be constructed by the Edison Electric Illumination company, in certain specified streets, as the Board of Electrical Control may require: second, the Subway company shall sell and convey such subways to the city at any time after Jan. 1, 1897, upon the demand of the Commissioners of the Sinking Fund, at the actual cost of the subways, provided that if the subways have not yielded a profit of 10 per cent. the city shall make up the deficiency. Another provision prohibits the company from mortgaging the subways when built, for more than 50 per cent. of their actual cost, so that if the city decides to buy them there will be some limit to the bonded indebtedness to be assumed.

The meeting of the Board of Electrical Control, to consider the entering into an amended contract with the Standard Subway construction company, was to-day adjourned until Tuesday next, because of the illness of Commissioner Moss.

The Assembly Committee on Electricity listened to arguments on the Clark telephone charges regulation bill at Albany Thursday night. Frank S. Gardner, James Talcott and Simon Sterne of New York, counsel for the Telephone Subscribers association of New York city were present, claiming to represent 5,000 telephone subscribers in New York and Brooklyn. J. W. Warner, Isidor Strauss, and Charles H. Shepard of Brooklyn were also present. Mr. Sterne made an elaborate address in which he endeavored to show that a rental of $80 per year was enough for a telephone in a large city. He believed that excellent service could be given at this rate with good profit.

The report of the committee which investigated electrical matters in this city recently was adopted by the senate Thursday. The demand for the report is so great that 5,000 additional copies were printed. They have all been distributed.

Dr. Norvin Green, president of the Western Union Telegraph company, celebrated his golden wedding Wednesday.

The project to tunnel East river is assuming a tangible shape since the New York & Long Island Railroad company has taken hold of the matter. This scheme was suggested some years ago by Gen. John Newton while he was engaged in engineering plans which cleared the Hell Gate channel. It will take two years to complete this tunnel at a cost of about $5,000,000. The electric motor will be applied to this tunnel system on account of its many advantages, being noiseless, free from dust and cinders, and economical in its running. The electric light will illuminate the tunnel. The matter now rests with the aldermen, who have hitherto been the sole objectors, and now that a perfectly responsible corporation is back of the enterprise, they should lend their hearty support.

The American Institute of Electrical Engineers listened to a lecture Tuesday evening at Columbia College by Prof. Elihu Thompson, president of the society, on the "Phenomena of Alternating Current Induction." Over 300 were present, among whom were noticed many of the older members. The Hon. Seth Low, president of Columbia, in introducing Prof. Thompson gave a brief statement of the work in progress in the electrical department of the college. Some of the experiments with which Prof. Thompson illustrated his lecture were remarkable in showing the power of alternating current induction.

On Monday evening Prof. Chandler, of Columbia College, gave a popular lecture on "Volts, Amperes and Ohms" in connection with some interesting experiments with the direct current. Inasmuch as he had an audience of laymen rather than expert electricians his lecture partook of the

first discoveries and fundamental laws underlying the science of electricity. The experiments with a new arc light on an Edison current were very satisfactory.

With the opening of the base ball season comes the announcement that the electric light will be introduced as an adjunct. It appears impossible to satisfy the demand for base ball in this city. Besides the National League and Brotherhood teams here, we have the Metropolitans and other well-known organizations. Then again there are three first-class professional teams in Brooklyn—the Brotherhood, Association and the Bridegrooms. In Newark and Jersey City professional clubs are also maintained. But this will not suffice. It is announced that a large number of powerful arc lamps will be arranged about the Polo grounds, and that evening games will be played. If the scheme is put in practice the games will undoubtedly prove a great attraction for the numerous novelty seekers with which this city is always crowded.

Murderer Kemmler is now at Auburn prison where he will be executed during the week beginning April 28, unless a stay of proceedings again interrupts the progress of the legal machinery. His will be the first electrical execution. The second execution will probably be that of Joseph Wood, who was last week sentenced by Recorder Smythe to be executed May 11. W. H. T.

Denver, Col.

Denver, Col., April 5.—The Electric Motor Railway company building its line out Lawrence street is progressing finely. The company expects to have its road completed within sixty days along Lawrence, Curtis, Thirty-fourth avenue to Williams avenue, where cars will be run from West Denver across the city. This will be one of the best paying routes in the city, as it travels through a thickly populated district. The road begins near the Denver & Rio Grande shops, West Denver, and while it virtually ends at Thirty-fourth and Williams avenues, it is the intention of the company to extend the line out Williams avenue a couple of miles. This extension will not be built until this coming summer, yet if the residents along that avenue subscribe a reasonable subsidy the road will be pushed out that way immediately after it is completed to the present terminus decided upon.

The front of the Telephone company building, now in progress of erection on Lawrence street, displayed several ugly cracks that gave it a very insecure appearance. The great arch settled and on the center being taken out cracks were produced in the pressed brick work. Accordingly the entire affected front was torn down, and rebuilt according to the original plans.

The Rapid Transit Electric Railway company is a new corporation in Colorado Springs. The road will include about 16 miles of track and the Sprague overhead system has been adopted. F. F Downs of Denver has been engaged to take charge of the electrical equipment, while Owen Ford of the Edison Manufacturing company, will superintend the wiring. The officers of the company are: F. L. Martin, president; A. L. Lawton, secretary; A. A. McGoveney, treasurer. These gentlemen, with E. J. Eaton of this city and M. A. Leddy of Manitou, also constitute the board of directors. M.

Des Moines, Ia.

Des Moines, Ia., April 5.—The Electric Railway company has ordered twelve new cars, which will be heavier than any yet on the track. The iron for the north lines has also been secured, and the work of putting down the track on the Sixth and Ninth street lines will begin in about ten days. The rails for these lines will be 65-pound iron, heavier than any of the others. F.

Cincinnati, O.

Cincinnati April 5.—It is reported that the Cincinnati Electric Lighting company has purchased a controlling interest in the local Brush, Edison and Hauss companies, thereby securing control of the city lighting. The litigation over the Brush contract with the city promises to bring out a formidable array of legal talent.

The hearing of testimony in the matter of the conditions under which the wires of the Edison General Electric company may be put under ground, was concluded Wednesday evening. The franchise has been granted, and in general the details of the work have been agreed upon, but there are still some matters in abeyance. What the company wishes to do is to have the privilege of laying its style of conduit in alleys, where it can be done, otherwise on both sides of the street. The first of the electrical experts to be called by the city was N. W. Perry, E.M., who was on the stand on Monday and resumed his testimony Wednesday. In reply to questions, he stated that where electricity was distributed at low potential, as proposed by the Edison company, it would be impossible for them to lay beneath the ground at one time sufficient copper to anticipate all future wants. It would be impossible from commercial considerations alone, because the amount of copper would increase as the square of the quantity of electricity transmitted. If, therefore, the Edison company should bury at once all the wire necessary for possible future demands it would involve an investment of unproductive capital that would render such an undertaking commercially prohibitory. If, on the other hand, it buried its wires only as the demand for new ones increased, it would involve the reopening of the streets as often as such a demand became apparent. Prof. Perry stated that he believed the burial of electric wires of both high and low potential currents to be, if a proper system is adopted, not only feasible but practical and desirable, both to the electric companies and to the public. He testified that there were no electrical difficulties in the way, that whatever had heretofore existed had already been met, and abundant experience, both in this country and in England, had shown that the burial of the wires was not only a mechanical but an electrical and a financial success. Continuing, the professor stated that there was a class of subways usually known as the "drawing in and out" conduits which could be built cheaply of any size, and containing as many ducts as seemed necessary. If one of these were once laid, it would never be necessary to tear up the streets a second time, either to increase the size of the wires, to repair breaks in the insulation, or to increase the number of wires. Such a conduit, he said, could be used by all comers on equal terms—the Edison company included. High and low potential wires could lie side by side in separate ducts, and each class of wires could have its appropriate insulation—features that could not be enjoyed where the proposed Edison ducts were used. Prof. French sustained Mr. Perry's views and advised the same course. O.

Dallas, Tex.

Dallas, Tex., April 5 —The progress of Dallas finds almost daily evidence in some new and solid project. Last month was noted for the development of two undertakings, which seem to be in conflict for possession. The Dallas Electric Railway company filed a charter at Austin for the construction of an electric railway, the incorporators being R. M. Dicksoo, H. C. Burlen, and R. S. Vivian. It is their intention, they say, if granted the franchise, to build and equip an electric line over Elm street, and thence through East Dallas, in the direction of the Episcopal college. Mr. Burlen states that the capital for this undertaking comes from Kansas City; that, if granted the franchise, guarantees will be given to have the road running by fall, and that the coaches, which are to cost upward of $4,000 each, will make the trip from Market street to the Episcopal college in twenty minutes. N.

St. Louis, Mo.

St. Louis, April 5.—The Benton and Bellefontaine Street Railway company Tuesday had its annual election of directors, the board chosen being composed of Charles Parsons, James Campbell, John T. Davis, George E. Leighton and Robert McCulloch. Later Mr. Campbell was elected president. There have been rumors for several days that the road had been sold and that the Chicago syndicate owning and operating the Citizens', Cass Avenue, Northern Central and Union companies were the purchasers. The result of the election, however, indicated that James Campbell had swallowed up the property. O,

Louisville, Ky.

Louisville, Ky., April 5.—Lonisville will doubtless have, before the year is out, more than 100 miles of street railway operated by electric motive power. All of the lines have been consolidated and the work of supplanting mules by electricity is proceeding. Hardin H. Littell, of the Louisville Railway company, has just returned from an extensive trip through the East for the purpose of examining the working of the various electric systems. He recently said: "We expect as soon as the change can be made to supplant the mules with electricity. To do so will cost about $100,000,000. We desire to issue bonds to raise the money, and to do this legislative authority is necessary. If we are not given the privilege of issuing bonds we will equip the various lines one at a time, as our means will permit. We do not expect to increase our business by the adoption of the electric system for all our lines, but we want to keep pace with the progress of improvement. The operating expenses of an electric line are less than those of a horse power line, but the great expense of equipment and the interest on the money invested must be taken into consideration. When we get the electric system on all the lines not a city will compare with ours in street railway accommodation. Three generating establishments will be necessary. In case one should be accidentally rendered useless there would be sufficient power left to prevent serious interruption. It is best to have more than one station in order to be exempt from interference by fires and other emergencies." B. A.

Lincoln, Neb.

Lincoln, Neb., April 5,—The committee appointed by the Real Estate exchange to induce a new company, intending to engage in the manufacture of electric light supplies in the West, to consider the advantages of Lincoln, has been able to make gratifying progress The company had originally intended to locate in Omaha, Kansas City, or Denver. Before the Lincoln committee reached the manager, he had decided in favor of Kansas City, and the machinery was purchased and ready to ship to that place. The Lincoln men were not daunted by this intelligence, and began an active campaign to secure the industry. The shipment on the machinery to Kansas City was delayed, and after considerable correspondence by mail and wire, the company agreed to come here if furnished free factory room and power for one year. Arrangements have been made for securing the room needed in connection with the large works of the Nebraska Planing Mill company. The accommodations will cost about $1,200, and as soon as this sum is secured the factory will be located here.

All kinds of electrical supplies will be manufactured. The capacity at the outset will be 500 lamps daily. The company has ample capital. T.

Kansas City, Mo.

Kansas City, Mo., April 5.—C. S. Rusling of the Thomson-Houston Electric company, closed a deal yesterday with William B. Tucker, consulting engineer of the Laredo Improvement company, for the purchase of an electric plant for Laredo, to cost $50,000.

A contract has been awarded to the Thomson-Houston Electric company by the Consolidated Cities & Chelsea Park Railway company for equipping with electric motors four cars and putting in three miles of overhead construction. The amount involved will be about $40,000. The work will be completed June 1. The road is in Kansas City, Kan., and runs from a point near Riverview station to the vicinity of the Kingan Packing company's plant.

Arrangements are pending between the American Electric Light company and the Kansas City Gas Light & Coke company, whereby the latter leases to the former part of the tract in the southeast part of the city, and the former will there construct additional power facilities. It is stated that two 500 horse power engines will be added.

Notice has been given that a special meeting of the stockholders of the Edison Electric Light and Power company will be held May 31 for the purpose of voting upon a proposition to increase the capital stock from $100,000 to $150,000.

The Gas works at Carthage, Mo., and the electric light plant of that city have been sold to capitalists from Fort Scott. Articles of incorporation have been filed with the county recorder for a new corporation to be known as the Carthage Light and Fuel company, which has a capital stock of $100,000. The new company took possession on April 1. The following is the list of stockholders: H. C. Messenger, Carthage; H. A. Malin, C. H. Malin, S. B. Malin and George B. Campbell, Fort Scott. They will make many important changes. At the same time articles of incorporation were filed by the same persons as stockholders in the Joplin Light & Fuel company for a like amount of stock, all paid up. They will take the Joplin gas works April 15.

H. Christopher, proprietor of Pettle Springs, Mo., has completed arrangements for constructing and equipping an electric railway, to be operated between Warrensburg and the Springs. The road bed has already been graded. The line will be in operation by May. The road will cost $40,000.

The electric light plant of Slater, this state, has closed down. Trouble has existed between the company and the city for more than a year on account of alleged unsatisfactory service. The controversy recently culminated in the city authorities serving notice on the company of a refusal to pay for the lights after that day. The company two years ago was granted a ten years' franchise. The city paid $2,250 per year for the lights. The plant is owned by a New York firm. It will probably be bought by a local syndicate.

The plant of the Chillicothe, Mo., Waterworks, Electric Light & Gas company has been sold by Receiver W. E. Gurley in the suit of the bondholders for default of interest, to Alexander G. Black, a New York capitalist and president of the reorganized company, for $50,000.

The city council of Neosho, Mo., will at once submit to the voters the proposition: "Shall we have waterworks

and electric lights?" The question will be decided in the affirmative, it is predicted.

The preliminary bill granting to C. A. Walterhouse and others a franchise for an electric motor or horse railway on portions of St. Louis, Jefferson, Elm, Dollison and Cherry streets, in Springfield, Mo., has been passed by the city council of that place, which has also granted a franchise to the Springfield District Telegraph company.

Horace Keefer of this city, was surprised last week by the news that the thirteen miles of the Valley Center motor line in Wichita, which he tried to tear up the week before, and which he was enjoined from interfering with, had been torn up, and was in possession of the rival claimants, the Wichita Electric Street Car company, who set nearly 200 men to work at different points on the road one night. The first injunction suit is still pending. P.

THE ELECTRIC LIGHT.

A contract for a 2000 alternating plant at Lexington, Ky., has been awarded the Westinghouse company.

The confectionery store of John Kranz at 80 State street, Chicago, will be lighted by 300 Thomson-Houston incandescent lights.

The National Electric Construction company will install a 300 light Thomson-Houston incandescent dynamo in the new *Inter-Ocean* building at Chicago.

The capacity of the Oakland Gas, Light & Heat company, Oakland, Cal., will be increased by the addition of a Thomson-Houston 35 light arc dynamo.

A. H. Revell & Co., Chicago, have exchanged their gas engine for a Thomson-Houston 10-horse power motor, which they will use for power in the future.

The San Jose, Cal., city council has passed an ordinance over the mayor's veto granting the Electric Improvement company of that city a franchise and the contract for street lighting.

The Edison company is trying to get a franchise in Oakland, Cal., and has applied to the city council for the same. It promises to bury its wires and establish a $35,000 plant.

The Cobb Electric Lamp company has been incorporated at Chicago, with a capital stock of $100,000, to manufacture electric lamps; incorporators, C. E. Gaylord, C. K. White and M. J. Treed.

The Ridgedale Electric Light & Power company has been incorporated by C. A. Lyerly, S. W. Divine, J. S. O'Neal and others to erect electric light plants, power house, etc., in Tennessee.

The Laredo Improvement company has purchased two 50 light arc and two 650 light alternating current incandescent machines from the Thomson-Houston Electric company, which it will use to light the city of Laredo, Tex.

The Thomson-Houston Electric Light company and the Brush Electric Light company at Memphis, Tenn., have consolidated, thereby increasing their capital stock to $200,000. They will erect a power house to operate the street railways.

The Davidson Theater, Milwaukee, Wis., is to be lighted with 1,600 incandescent lights and 10 arcs. The Mather incandescent system will be used for the incandescent lights and the Easton arc lamps will be employed. The order was secured by J. H. Reid, western manager for the Mather and Easton companies.

The Brush company has instituted additional legal proceedings, according to a New York dispatch, which says: Suits have been brought in the United States District court by the Brush Electric company against the United States, the Excelsior, the New American Arc Light, and the Ball Electric Light companies to restrain them from using the double carbon arc lamps, alleged to infringe patents owned by the plaintiff.

Some time ago it was announced that the plants of the Batavia (N. Y.) Gas Light company and the Consumers Electric Light & Power company had been purchased by a syndicate with a view to consolidating and reorganizing the same. The companies have been reincorporated as the Consolidated Gas & Electric company of Batavia, with Messrs. Samuel D. Purdy, Henry Craft, Chas. H. Caldwell, Richard C. Garhart and Russell L. Kinney as the incorporators. The capital stock has been put at $100,000.

The fifth annual report of the Board of Gas & Electric Light commissioners of Massachusetts shows that there are in the state seventy-five gas companies, of which twenty-six have the right to supply both gas and electricity, and no fewer than 100 electric light and power companies. The number of public gas lamps continues to diminish in about the same ratio as last year, electric lights taking their places. The coal gas companies lost 999 lights. The year was an active one for those engaged in the electric lighting business. There were forty-four new electric light and power companies incorporated.

The property of the Weston Electric Light company, which has been operated by the United States Electric Light company in Newark, N. J., since 1881, was formally transferred to the United States Electric Light company last week, and a mortgage for $750,000 was recorded as given to Marcellus Hartley of New York, who, with H. B. Hyde and Anson Phelps Stokes, has controlled the stock for years, and is one of the vice-presidents of the company. A little more than a year ago the Westinghouse Electric company took the works on a contract with the United States Electric Light company.

Mauch Chunk, the capital of the American Alps, has just been provided with an electric light plant, and how much the citizens are elated over the innovation in the lighting of their streets can best be judged from the following which appeared in the Mauch Chunk *Daily Times:* "The streets of the Switzerland are now illuminated by electric light. The arc dynamo was run yesterday evening for the second time, and the forty lamps that are planted throughout the 1st and 2d wards and East Mauch Chunk shed forth their brilliant rays until quite a late hour to the delight and pleasure of all our people, and to the evident satisfaction of the managers of the Electric Light company." As has already been stated in these columns, the system used by the Mauch Chunk Electric Light company is the Westinghouse.

The Westinghouse Electric company has recently received an order for 750 Shallenberger meters of various sizes, which is the largest single order for these instruments which has come to the company since it placed the meters upon the market. The order comes from across the Atlantic, having been placed by the Metropolitan Electric Supply company of London, England, which several months ago decided to adopt the Westinghouse alternating current system for use in its large central stations in the great metropolis. When these meters are received in London 1,100 meters of the Westinghouse manufacture will be employed there. The Metropolitan Electric Supply company first ordered 10,000 lights' capacity in dynamos from the Westinghouse company, and about the 1st of February last placed a second order, for the purpose of increasing its capacity to 25,000 sixteen candle power lamps.

The Westinghouse Electric company reports the following central station business for the month of March, 1890: Incandescent plants—Tampa, Fla., 500 lights (increase); Bluff Point, N. Y., 1,500 lights; Kewanee, Ill., 750 lights; Warren, Ohio, 750 lights; Rochester, Pa., 500 lights; Shelby, N. C., 500 lights; Methuen, Mass., 750 lights; Nashville, Tenn., 3,000 lights (increase); New York, N. Y., Mt. Morris company, 1,500 lights (increase); Canton, Mass., 750 lights; New York, N. Y., United Electric Light & Power company, 15,000 lights (increase); Hoquiam, Wash., 750 lights; Boston, Mass., 3,000 lights (increase); Fort Collins, Colo., 750 lights; Girard, Kan., 750 lights; Auburn, Me., 1,500 lights (increase); Wilmerding, Pa., 1,500 lights; total, 33,750 lights; arc plants—Warren, O., 105 lights; Joliet, Ill., 65 lights; Methuen, Mass., 40 lights; Nashville, Tenn., 540 lights; New York, N. Y., 125 lights (increase); Hoquiam, Wash., 50 lights; Cumberland, Md., 45 lights; Girard, Kan., 25 lights; Boston, Mass., 125 lights (increase); Harriman, Tenn., 60 lights; Canton, Mass., 35 lights; total, 1,215 lights.

The Hawkeye Electric Manufacturing company of Davenport, Ia., has just completed a motor circuit for the Capital City Gas Light company of Des Moines, Iowa, which is now running the only exclusively power circuit in the state of Iowa. A 50,000-watt machine for this purpose has been installed and already in the neighborhood of 50 horse power motors is connected thereto. Among other work just completed by the Hawkeye company are the plant for the Bloomfield Electric Light & Power company at Bloomfield, Ia., of 700 lights; the city of Winterset, Ia., 700 incandescent and 15 arc lights; a plant of 300 incandescent lights for the Drake Block, St. Paul, Minn.; 150 lights for the Earhuff Organ & Piano company, St. Paul; 75 lights for the Phœnix Mill company, Davenport, Ia.; Davenport Malt & Grain company, 75 lights; McCullough Block, Davenport, Ia., 150 lights. The company has also enlarged the station capacity of the Kimball House and Burtis Opera house, Davenport, from 400 to 650 lights. It has in course of construction a plant of 300 lights for the Sioux City Engine company, Sioux City, Ia., and is building a power and light station at Muscatine, Ia., which is designed for a capacity of 3,000 lights. The Hawkeye company is employing about 150 men in its work, which force they expect to enlarge this summer.

THE ELECTRIC MOTOR.

Electric launches are expected to supersede yachts on the Thames in a few years. At present there are about 30 of these launches on the Thames river.

The North & South Rapid Transit company of St. Louis, will be obliged to change its route so as to avoid crossing the tracks and conflicting with the Cross Town Electric Railway company.

At Rockville, Md. a company has been incorporated by John E. Beall, Frank Walsh, H. B. Davidson, Spencer Watkins and others for the purpose of building an electric railroad to Tennallytown, D. C., about 10 miles distant.

The Kansas City, Mo., elevated road has been granted a franchise to construct an electric line two miles long over the Armstrong viaduct. Four cars will be operated. The overhead system will be adopted and the line will be finished August 1. The new line will be an extension of the elevated road system, which is now 14 miles in length.

The Davenport (Ia.) & Ft Scott Investment company has just closed a contract for changing the street car line in Ft. Scott, Kan., to an electric line. The contract has been let to the Sprague Equipment company, at a cost of about $50,000. A local paper says the value of real estate along the line has increased 50 per cent. and is still booming.

At Springfield, Ill., preparations are being made to convert a portion of the street railways of the city into electric railways, and a preliminary meeting was held last week by property owners, mainly upon Fifth street, with a view to perfecting an organization in opposition to stringing overhead wires for electric railway purposes. There are indications that the whole matter may go into the courts.

The boycott inaugurated by the Northwestern Improvement company of St. Louis, and the residents of North St. Louis against the bobtail cars, which was to go into effect April 2, has been declared off in view of the fact that John Scullin has agreed to furnish conductors for his cars the 1st of October, and to change the motor power from horse to that of electricity. This action was agreed upon at a public meeting and a resolution was adopted containing the following provisions: "In view of the fact that the city council and assembly have seen fit to pass the bills authorizing certain street railway companies to change their motive power from horse to that of electricity, be it therefore *Resolved*, That a committee of three be appointed to call upon his honor, the mayor of this city, to urge him to sign the bills referred to above at once, thereby pleasing the members of this association and giving the citizens of North St. Louis the much needed relief asked for." Residents of other parts of the town, particularly Bryan's Hill and College Hill refused to follow the example of their neighbors and the Union line will accordingly be boycotted until it has provided improved facilities.

THE TELEPHONE.

The supervisors of San Francisco, Cal., have passed the bill granting the Pacific Bell Telephone company the right to establish an underground conduit service, despite the mayor's veto.

The complaints in regard to the Paris telephone system have induced the French minister of post and telegraphs to decide upon the erection of a large telephone exchange in the center of Paris, with accommodation for 30,000 subscribers.

THE TELEGRAPH.

The Japanese government is contemplating connecting the Lin-Chin Islands by a submarine cable with Japan. It is also proposed to establish a meteorological observatory in the islands which occupy a position of considerable importance for observations in the course of the typhoons which are encountered in the China seas. The system of telegraphic communication contemplated will make these observations of the greatest importance to the shipping interests.

The Virginia legislature several years ago passed a law to the effect that telegraph companies could build their lines along any highway in the state without getting the consent of property owners. The State Supreme court has just sustained the decisions of the courts below that the law is unconstitutional as it took private property without providing compensation therefor, and that the Western Union company, which availed itself of the law, is now a trespasser upon those lands.

Miscellaneous Notes.

At the meeting of the American Institute of Electrical Engineers March 18th, thirty-two associate members were elected.

The Northwest Electric Construction and Supply company gave its regular annual dinner at the Hotel Ryan, St. Paul, Monday evening last.

The American Street Railway association has appointed the following gentlemen as the World's Fair committee to arrange for an exhibit illustrating the industry: George W. Pearson, Washington, D. C.; G. Hilton Scribner, New York, N. Y.; Charles B. Holmes, Chicago, Ill.; E. B. Edwards, Philadelphia, Pa.; Henry M. Whitney, Boston, Mass.; Thomas Lowry, Minneapolis, Minn.; Charles Green, St. Louis, Mo.; Edward Lusher, Montreal, Can.; William H. Martin, San Francisco, Cal.; George B. Kerper, Cincinnati, O; William J. Richardson, Brooklyn, N. Y. It is confidently expected that the street railway exhibit under the auspices of the American Street Railway association will be one of the most interesting at the Exposition.

Allen R. Foote addressed the convention of the Ohio Gas association at Toledo recently on the "Municipal Control of Gas and Electric Lighting Plants." He said: "I say to the people of all municipalities that have committed themselves to the principle of municipal ownership, you have entered upon an economic policy that will ultimate in industrial slavery. You sought escape from a limited monopoly, and have established an absolute monopoly. You are levying a tax on consumption, instead of possession. This is the most inequitable form of taxation." In conclusion Mr. Foote said: "When the municipality owns the plant, the wage earner and the millionaire pay exactly the same rate for the gas they consume. The profit on that gas compels the wage earner to pay a tax a thousand times greater in proportion to his income than the tax paid by the millionaire. The policy of municipal ownership of lighting plants can be successfully combated upon practical lines. Let the whole truth be known regarding the accounts of such plants, let the people become thoroughly educated as to the workings and tendency of such undertakings, and, speaking of one of them as representing the whole, the sale of the Philadelphia gas plant to private ownership and management, will become a political necessity."

Personal Mention.

A. H. Gould of Sioux City, Ia., visited the Chicago Electric club last week.

It is now announced that Edison will remain at Charlotte, N. C., during the spring and develop his process of reduction or concentration of gold ore by electricity. He also hopes to perfect a machine for picking cotton.

Business Mention.

The New York Electrical Supply company has issued a handy catalogue of the numerous devices which it handles, and its well-known specialties.

Noyes Brothers, Chicago, have issued a nicely illustrated catalogue, showing their excellent line of electric light fixtures to advantage. There are many new designs shown, and much that will interest electric light men and construction companies is presented in an attractive form.

The Weston Electrical Instrument company of Newark, N. J., which made such a splendid exhibit of their instruments at Kansas City Electric Light convention, is about completing arrangements to occupy four floors of one of Newark's finest factories. An increased demand for Mr. Weston's accurate and sensitive products has necessitated seeking greater accommodations.

The Keating Implement & Machine company of Dallas, Texas, has been appointed the representatives of the Abendroth & Root Manufacturing company of New York. The company will handle more particularly the celebrated Root new water tube boiler, and has already issued a neat illustrated circular setting forth the merits of this popular steam generator, which will be mailed to applicants.

The Western Electric company, Chicago, has issued a profusely illustrated catalogue in which its incandescent system is thoroughly described and its numerous advantages explained. When the system was perfected the apparatus was described in this paper. It has since been given a practical test and has proven thoroughly satisfactory. The company has installed a large number of plants and the system continues to grow in favor.

The D. M. Stewart Manufacturing company of Chattanooga, Tenn., manufacturers of lava insulators, have been obliged to more than double their facilities for turning out this class of work, so great has been the demand for these goods. The Thomson-Houston company alone have orders with them nearly all the time for over 200,000 insulators. The Brush company of Cincinnati in a letter to the company writes: "We desire to express to you our appreciation of the invaluable qualities possessed by the patent lava insulators you have furnished us. We have found it to be the only insulator that can stand the severest tests, and have no hesitancy in expressing the opinion that it will stand any and all tests that an electrical insulator can be put to."

The Pond Engineering company will furnish and erect a complete steam plant for the Central Electric company of Lexington, Ky., consisting of five 75-horse power Armington & Sims' engines, six 125-horse power boilers, Lowe heater, Buffalo pumps, etc. Power will be furnished for an electric railway and both arc and incandescent lamps. The Pond Engineering company will furnish Armington & Sims' engines to the Elgin (Ill.) street railway, and have just received the third order from the Laredo (Tex.) Improvement company. It will furnish three 100-horse power Armington & Sims' engines (making five in all to the Laredo company), four boilers of 125-horse power each, Lowe heater, duplicate boiler feed pumps, etc., including everything necessary to make the plant the most complete and best designed in the state of Texas. A very substantial power house will be erected; also a fine brick stack 100 feet high. The electric railway and city lighting plants will be driven from this station. The Pond Engineering company are also putting in a 50-horse power plant, including an Armington & Sims' engine, into the state printing office at Austin Tex.

Prof. H. G. Torrey recently made an extended series of tests to ascertain the qualities of the best known anti friction metals when subjected to work such as is in accordance with everyday practice. The tests were made for the purpose of ascertaining the comparative merits of the best known metals of this character under the severest conditions. Some thirty or forty metals were tested, and from these three or four were selected as the best These were then subjected to an extreme comparative test in order to ascertain without doubt which was the best for the purpose. In each case in the final test the best oil was used as a lubricant, extreme care was exercised in fitting the bearings and journals, and an accurate record was taken as the test progressed. With deoxidized genuine babbit running 15 minutes, with a pressure of 1,000 pounds per square inch, the metal wore considerably and flowed at the side. With Hoyt's genuine babbit metal for a run of 5 minutes, with 1,000 pounds per square inch, the result was in a measure similar to the above. With Posts' zero metal for a run of 10 minutes, with 1,200 pounds to the square inch, the metal showed extreme wear, and the box was practically destroyed. With Magnolia anti-friction metal, under a test of 50 minutes, with 1,200 pounds to the square inch, this being followed 25 minutes with 1,425 pounds to the square inch, the bearing showed only in a slight degree any evidence of the extreme duty it had to perform. In the six tests the diameter of the shaft was five inches, the velocity of the rubbing surface was 2,033 feet per minute, and the revolution of the shaft per minute was 1,600. The load placed upon the metal varied as given above. The Magnolia metal showed that under the most severe duty, running at an excessive speed and far overloaded, it maintained its original form and showed no evidence of undue wear or excessive heating. It will be noted that this test is at least four times that required by ocean steamers or by the government war ships, both of which cases may be taken as showing the extreme practice, or in other words, a metal which will stand the test above given has a factor of safety of at least four when compared with ordinary practice; or, to express it in another way, it will perform safely four times the work required under the usual conditions.

Electrical Patents.

Issued April 1, 1890.

424,493. Tablet for Telephones. John B. Morris, Cincinnati, O.

424,535. Electric Motor. Leo Bock, Jr., New York, N. Y.

424,544. Marine Electric Light. Alexander G. Donnelly, New York, N. Y.

424,562. Lightning Arrester. Osborn P. Loomis, Brooklyn, N. Y.

424,563. Lightning Arrester. Osborn P. Loomis, Brooklyn, N. Y.

424,575. Electrical Insulation. Thomas S. Reed, Jersey City, N. J.

424,595. Regulation of Electric Motors. Sigmund Bergmann, New York, N. Y., and George B. Scott, Lakewood, N. J.

The sixth claim follows:

"The combination, with an electric motor, of a regulator consisting of arms pivoted in place at one end and normally close together, a semi-cylindrical projection on each of said arms together forming a cylinder or wheel, a spring for drawing said arms together, and a lever or arm operated by the projections and having connection with the electric circuit."

424,606. Choking Electro-Magnet. Ludwig Gutmann, Fort Wayne, Ind.

Claim three is as follows:

"In a choking magnet, the combination of a number of coils inclosed internally and externally by an iron core, the said iron core having a smaller cross-section in its internal part than in the external portion, and a movable core adapted to substantially fill the central hole which is provided in said coils."

424,607. Method of Operating Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

The method consists in maintaining a circuit of constant potential and in shunting more or less of the current around said motors, according as the number of said motors in circuit decreases or increases.

424,635. Electric Call. Frank B. Wood, New York, N. Y.

Of the eleven claims we give the first:

"The combination, in an individual electric signaling apparatus, of two lines emanating from a central station, step-by-step mechanisms at the various stations governed by electro-magnets in one of said lines, adjustable arms controlled by said step-by-step mechanism, all of said arms being differently situated, signal receivers at the various stations governed by electro-magnets controlled by the other line and by the aforesaid adjustable arms, and a transmitter at said central station governing the circuit of both of said lines."

424,665. Safety Device for Electric Circuits. Charles G. Young, New York, N. Y.

The method consists in automatically electrically separating the poles of the generator from the main line when the latter becomes ruptured.

424,684. Pneumatic Telephone. Joseph G. Noreau, Quebec, Can.

424,695. Suspended Switch and Traveling Contact for Electric Railways. Charles J. Van Depoele, Lynn, Mass.

The thirtieth claim reads:

"The combination, with a contact wheel for overhead conductor, of a supporting-arm therefor, having a fender bridging the angle between the wheel and arm."

424,699. Electric Car Motor. Edward M. Bentley, New York, N. Y.

The method consists in disconnecting the driven mechanism mechanically from the motor, regulating the freed motor to prevent racing of the same, and, finally, in re-connecting the mechanism with the motor.

424,703. Electro-Magnet. George D. Clarke, Chicago, Ill.

424,725. Electric Indicator. Major D. Porter, Newton, Mass.

424,726. Electric Indicator. Major D. Porter, Brooklyn, N. Y.

424,729. Electric Trap. Francois Scherer, Paris, France.

The invention consists of a lure of some kind, as a light (for nocturnal insects), bait, etc., to attract the creatures, arranged within or behind an inclosure or screen, formed wholly or in part of a species of grid constructed of metallic rods or wires, placed side by side, said wires forming parts of an electric circuit.

424,734. Electric Motor. Lawrence T. Smith, Providence, R. I.

424,739. Electric Switch. Charles S. Van Nuis, New Brunswick, N. J.

424,743 Fire Extinguisher for Car Stoves Samuel S Weinberg, Baltimore, Md.

424,751 Electrical Conductor. John A. Barrett, Brooklyn, N. Y.

424,752. Arc Lamp. Ralph H. Beach, St. Paul, Minn.

Claim two follows:

"The combination of the lower carbon holder, the follower for depressing the upper carbon, the guide-rods on which said follower slides, the solenoid, the core of the solenoid, the tube connecting the solenoid and said guide-rods, and the spring for assisting in supporting the upper carbon holder."

424,778. Ventilating System for Electric Subways. William Gee, New York, N. Y.

Claim one is appended:

"The combination, with a man-hole or subway, of two ventilating pipes entering said man-hole or subway at top and bottom, respectively, one of said pipes being partially or wholly inclosed within the other and each opening at a different point above the surface of the ground or street."

424,786. Magnetic Pen-Holder. Edwin A. Hill, Reading, Mass.

424,809. Electrode for Secondary Batteries. James F. McLaughlin, Philadelphia, Pa.

424,810. Electric Locomotive. James F. McLaughlin, Philadelphia, Pa.

424,817. Boat. William H Patton, Chicago, Ill.

The invention consists in the combination, in a boat, with the screw or analagous propelling means, of mechanism for actuating the latter, comprising an electric motor operatively connected with the propelling means, a storage battery system connected with the motor to drive it, a dynamo electric machine for charging the battery, and an engine (and preferably, though not essentially a gas engine) for driving the dynamo.

424,818. Electric Railway Motor. Frank A. Perret, Brooklyn, N. Y.

424,827. Electro-Medical Belt. William J. Shelton, Columbia, Tex.

424,845. Electric Railway. Edward M. Bentley, New York, N. Y.

Claim eleven reads:

"The combination, in an electric railway, of a common conduit, two conductors therein connected to distinct systems, and a branch in the conduit, the two conductors following the two branches respectively, and crossing each other at the branching point."

424,848. Electric Railway. Francis O. Blackwell, New York, N. Y.

The invention consists in utilizing the posts employed for supporting the supply wire to carry at the same time an elevated railway structure.

424,860. Automatic Fire-Alarm. Charles A. Cox and Joseph F. Cox, Louisville, Ky.

424,866. Arc Light. Julien Dulait, Charleroi, Belgium.

424,887. Electric Railway. Walter H. Knight, New York, N. Y.

The first claim is given:

"The combination of a slotted conduit, a conductor inclosed therein, a contact device adapted to travel along said conductor, and an insulated conductor extending into said conduit, and having a detachable connection with said contact device."

424,888. Electric Railway. Walter H. Knight, New York, N. Y.

The last claim reads as follows:

"10. The combination of the conduit and inclosed conductor with the pocket or inclosure opening upon the street, having a glass shield and a removable protecting cover for said shield, and devices connected to the supply conductor housed in said inclosure."

424,891. Method of and Apparatus for Measuring Alternating Currents of Electricity. William Lowrie, Chas. J. Hall and Harold W. Kolle, London, County Middlesex, Eng.

The invention relates to a method of measuring alternating currents of electricity; and it consists in differentiating the wave of potential, so that there is a slight preponderance upon one side of the neutral line over the other. The difference of potential is available, and may be utilized for doing the work of measurement, either by mechanical means or by chemical action.

Claim thirteen is:

"The combination of an alternating current circuit, one or more converters, secondary circuits supplied by the converters, and suitable differentiating and measuring media connected with the secondary circuit."

424,910. Contact Device and Switch for Electric Railways. Charles J. Van Depoele, Lynn, Mass.

Claim one is appended:

"In electric railways, the combination of a main conductor, a branch conductor united to and extending therefrom, and a self-switching contact device comprising a grooved wheel provided with notched edges."

424,911. Electric Railway Motor. Charles J. Van Depoele, Lynn, Mass.

The first claim is given:

"A frame for an electric motor, comprising side arms and a magnetic yoke uniting the same, the arms and yoke being integral with each other and formed of magnetic material, and field-magnet cores removably secured to and magnetically united by said yoke."

424,921. Electrical Heater. John V. Capek, New York, N. Y.

Of the ten claims we give the fourth:

"As a heating resistance for electrical heaters, a strip of hardened asbestos coated with graphite."

424,922. Electrical Cooking Stove. John V. Capek, New York, N. Y.

The invention comprises a backing or platform of non-conducting material, a facing or filling of conducting material, and contacts for said conducting material of graphitized iron or nickel embedded therein.

424,928. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The object of the invention is to provide an electric railway, with a branch track or turn-out, in which the conductor or conductors for supplying the current to the car are preferably separate from the rails for the supporting wheels of the vehicle car.

424,929. Double-Faced Electric Clock. Erick W. Lindenau, Joliet, Ill.

424,935. Cable Grip. Edwin S. Reed, New York, N. Y.

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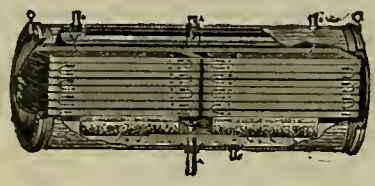

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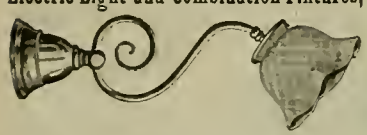

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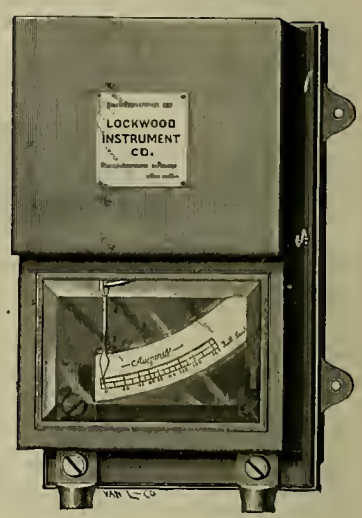

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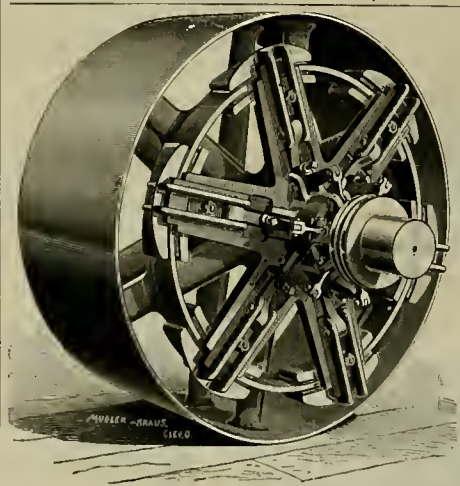

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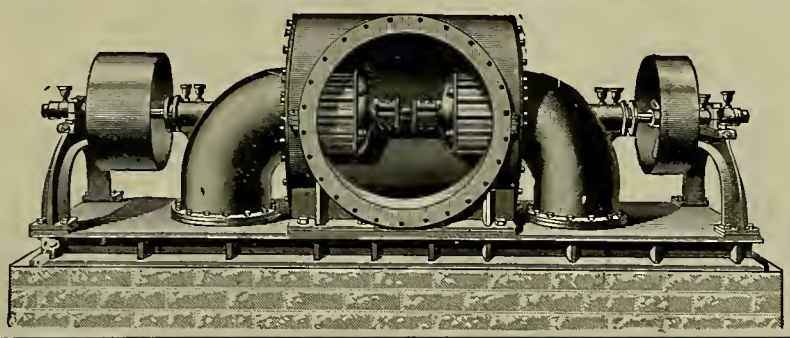

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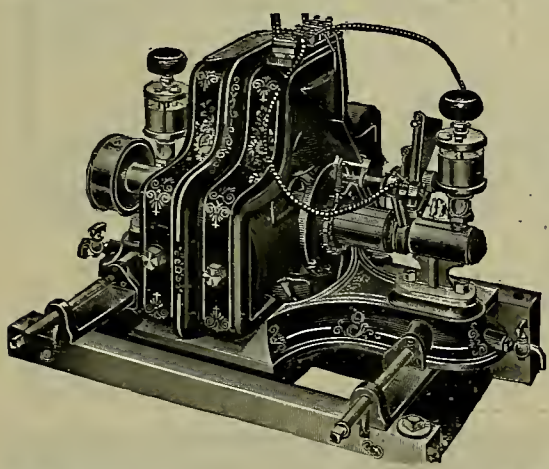

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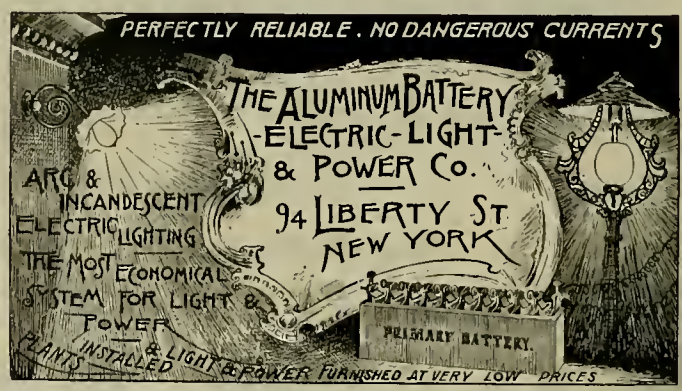

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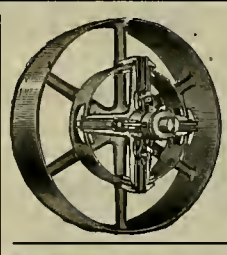

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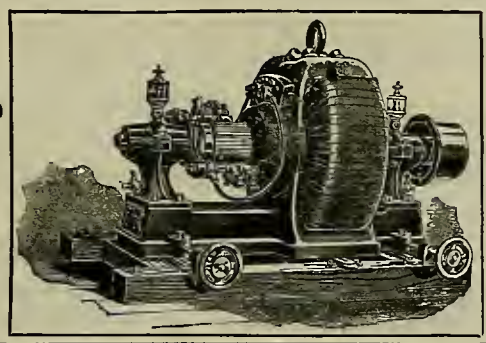

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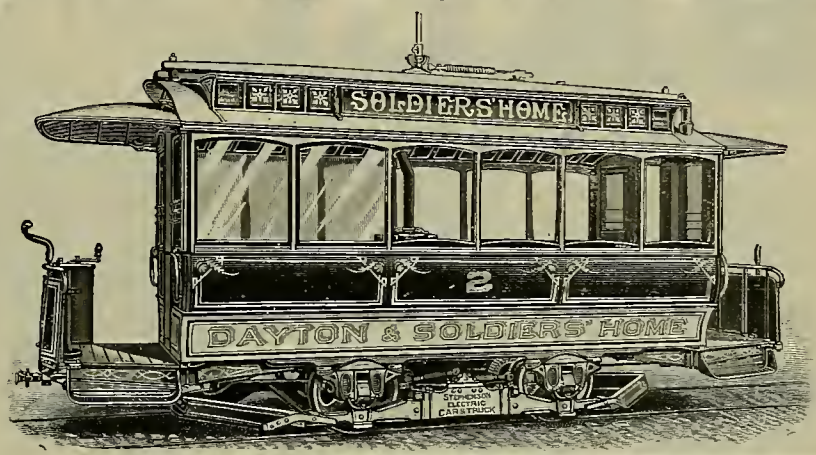

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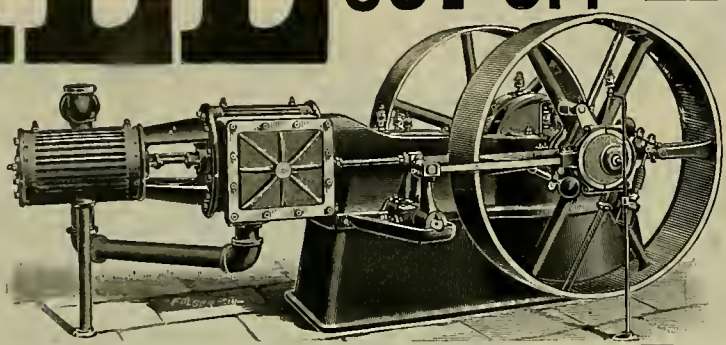

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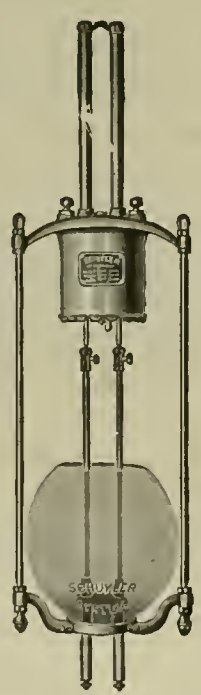

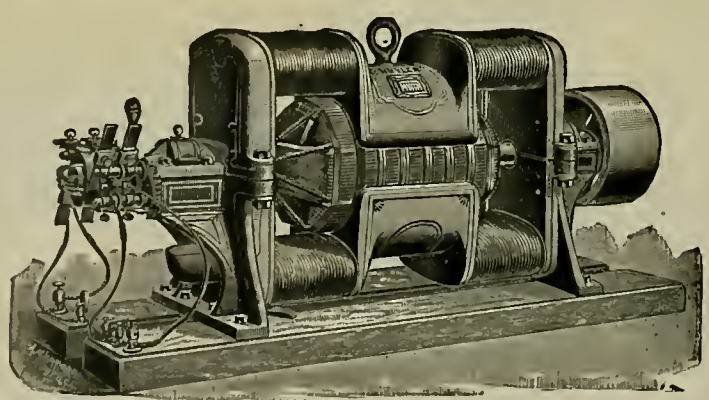

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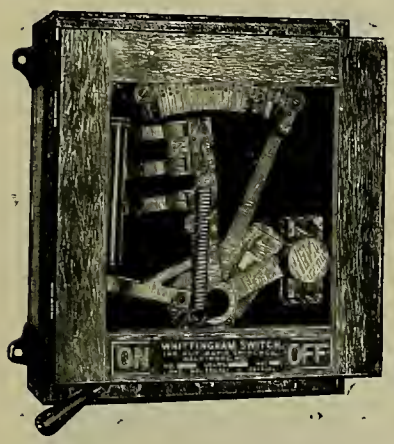

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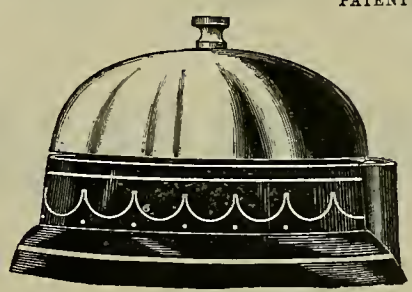

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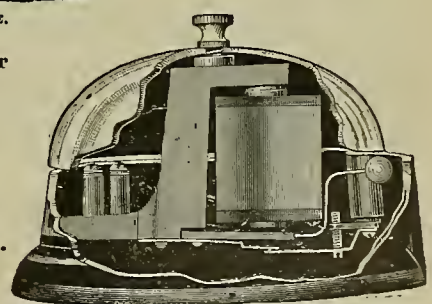

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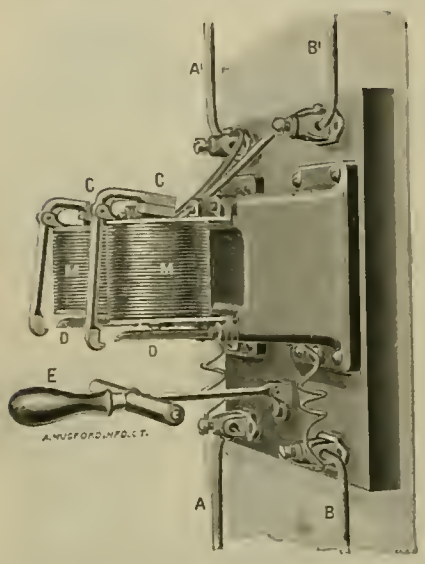

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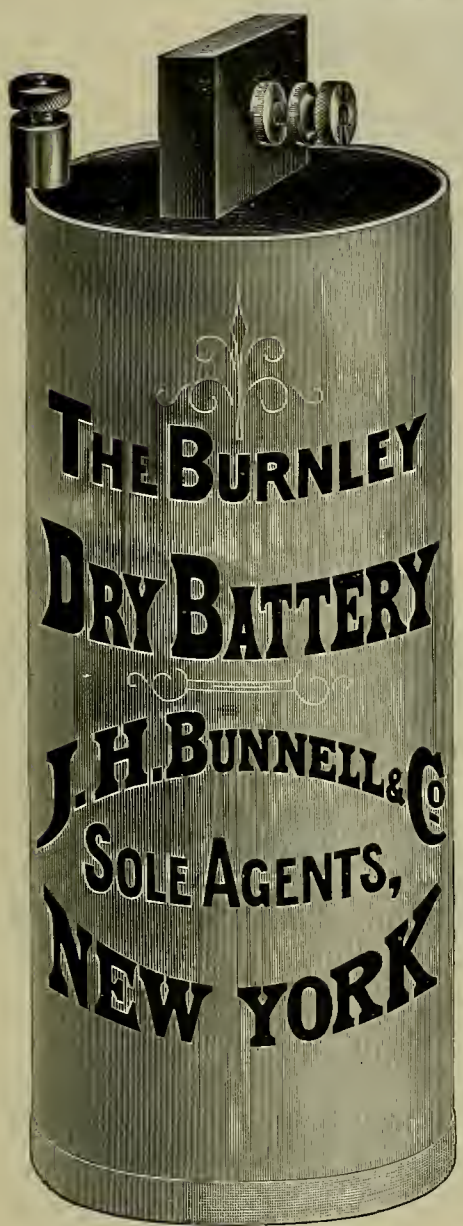

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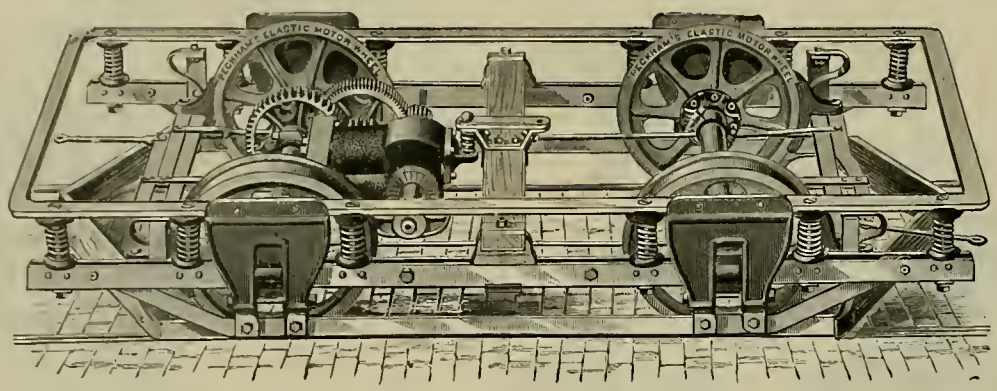

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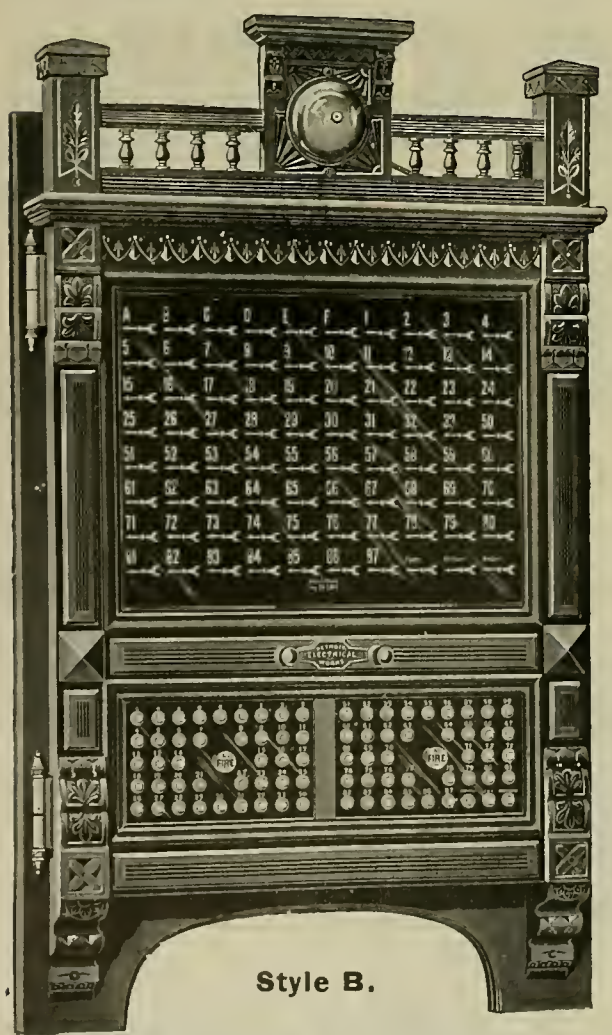

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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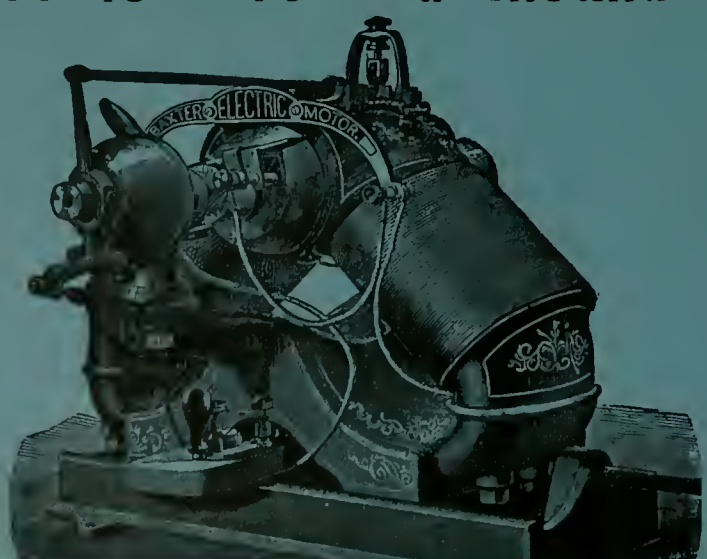

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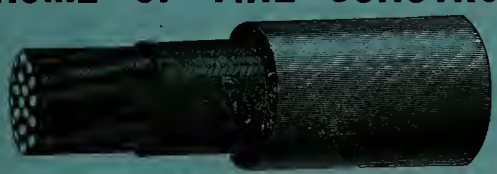

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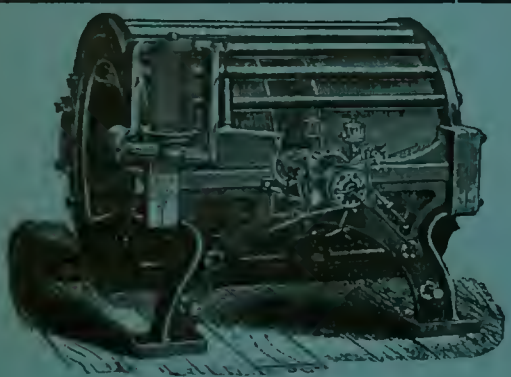

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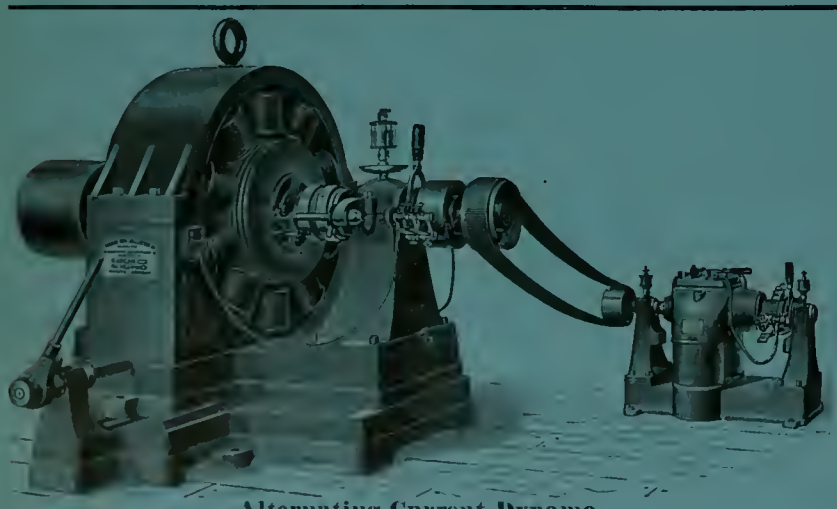

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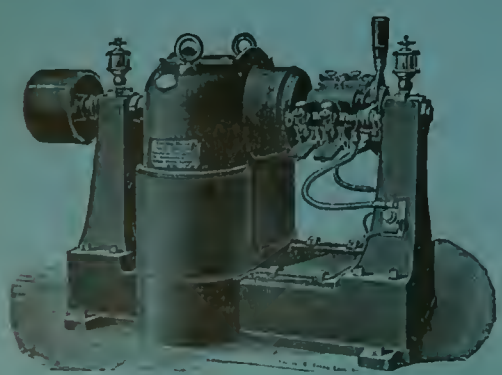

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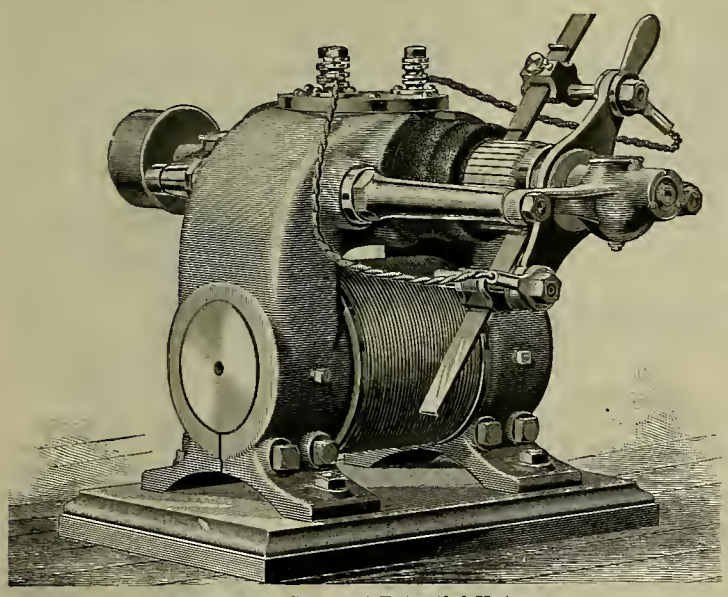

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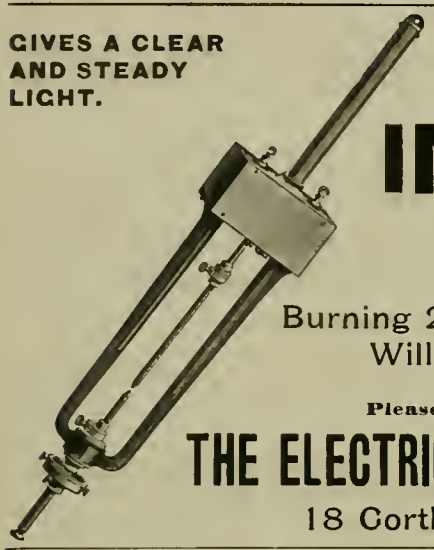

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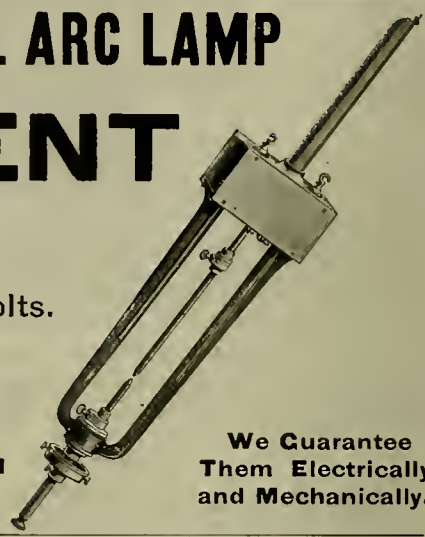

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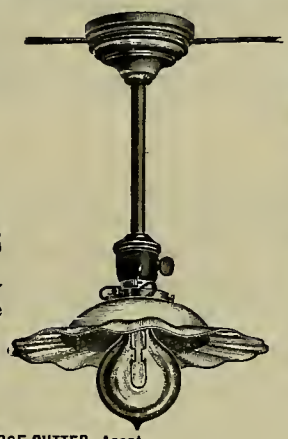

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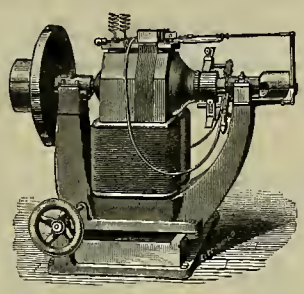

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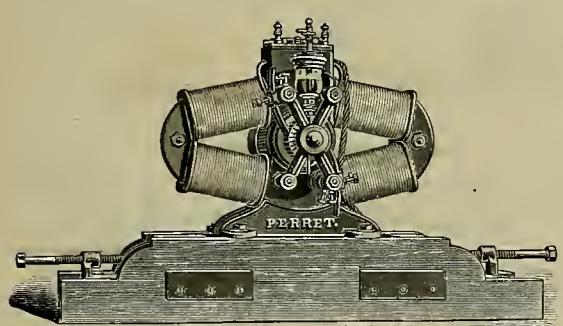

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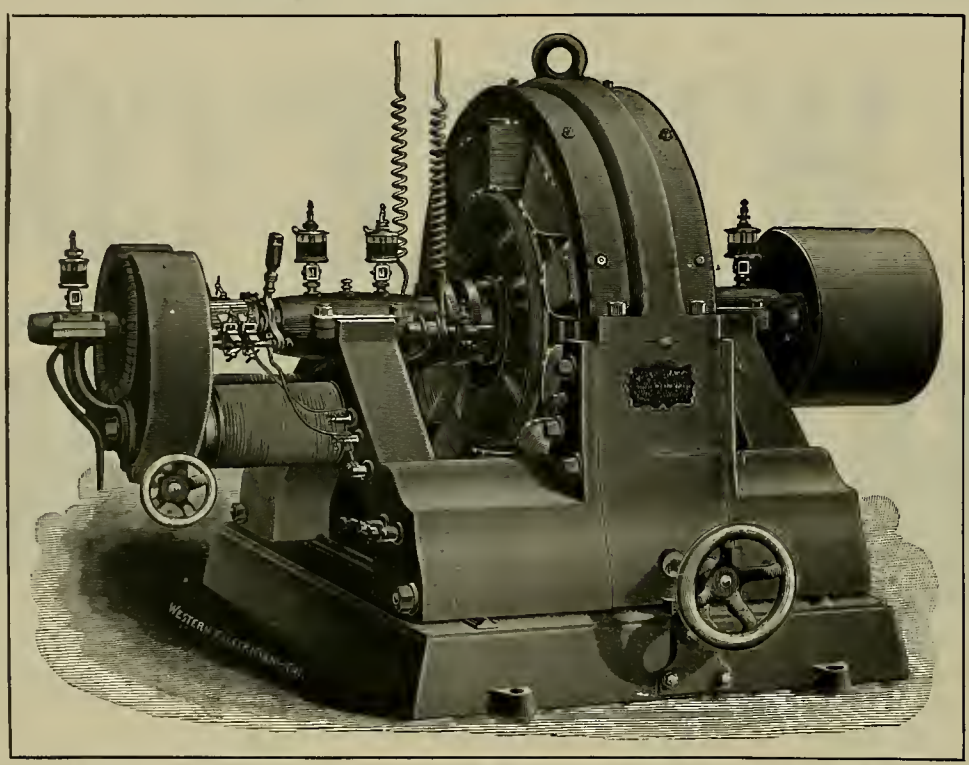

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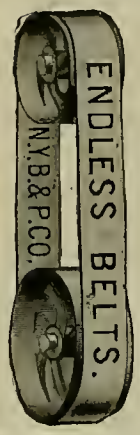

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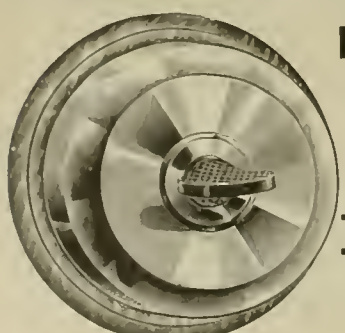

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EVERY SATURDAY.

Vol. VI. CHICAGO, APRIL 19, 1890. No. 16

Electrical Effects at the New York Lenox Lyceum.

The attractiveness of the Woman's Exchange Exhibition, which is now in progress at the Lenox Lyceum, New York, is enhanced by a number of brilliant electrical features. The building is admirably adapted to the display. The hall is almost circular, and the walls which are most beautifully decorated rise to a considerable height.

Mr. Edison has placed at the disposal of the executive committee, his entire Paris exposition exhibit. The phonograph is shown with an effectiveness never before approached, and the vocal records reproduced include songs by celebrated artists and the sayings of many of the most eminent men in Europe. The capabilities of the long distance telephone are illustrated with great completeness, connections being made with Boston, Philadelphia and other distant cities. By means of the same instrument the roaring of the Falls of Niagara can be distinctly heard.

The most striking object in the exposition is the "Tower of Light," Fig. 1, which stands in the center of the Lyceum auditorium. This is a column twenty-five feet in height and eight feet in diameter. The tower is covered with forty spiral rows of four candle-power incandescent lamps with globes of varied colors. Its capital is encircled with frosted 16-candle power lamps. Above these, streamers of smilax dotted with tiny lamps extend to the sides of the hall. The effect of the sparkling tower is striking in its beauty, and the whole arrangement constitutes a beautiful exemplification of the possibilities of electrical illumination.

The lamp receptacles on the tower are mounted on pliable wooden mouldings and are connected in parallel series of eight, and, as before described, are wound spirally around the tower. The terminals of the mouldings are carried to cut-outs on the inside of the tower. One pole of each of these cut-outs is carried to a common main wire, and thence to an equalizing resistance at one pole of a main cut-out. The other poles of the cut-out at the terminals of the mouldings, are carried to single pole plug

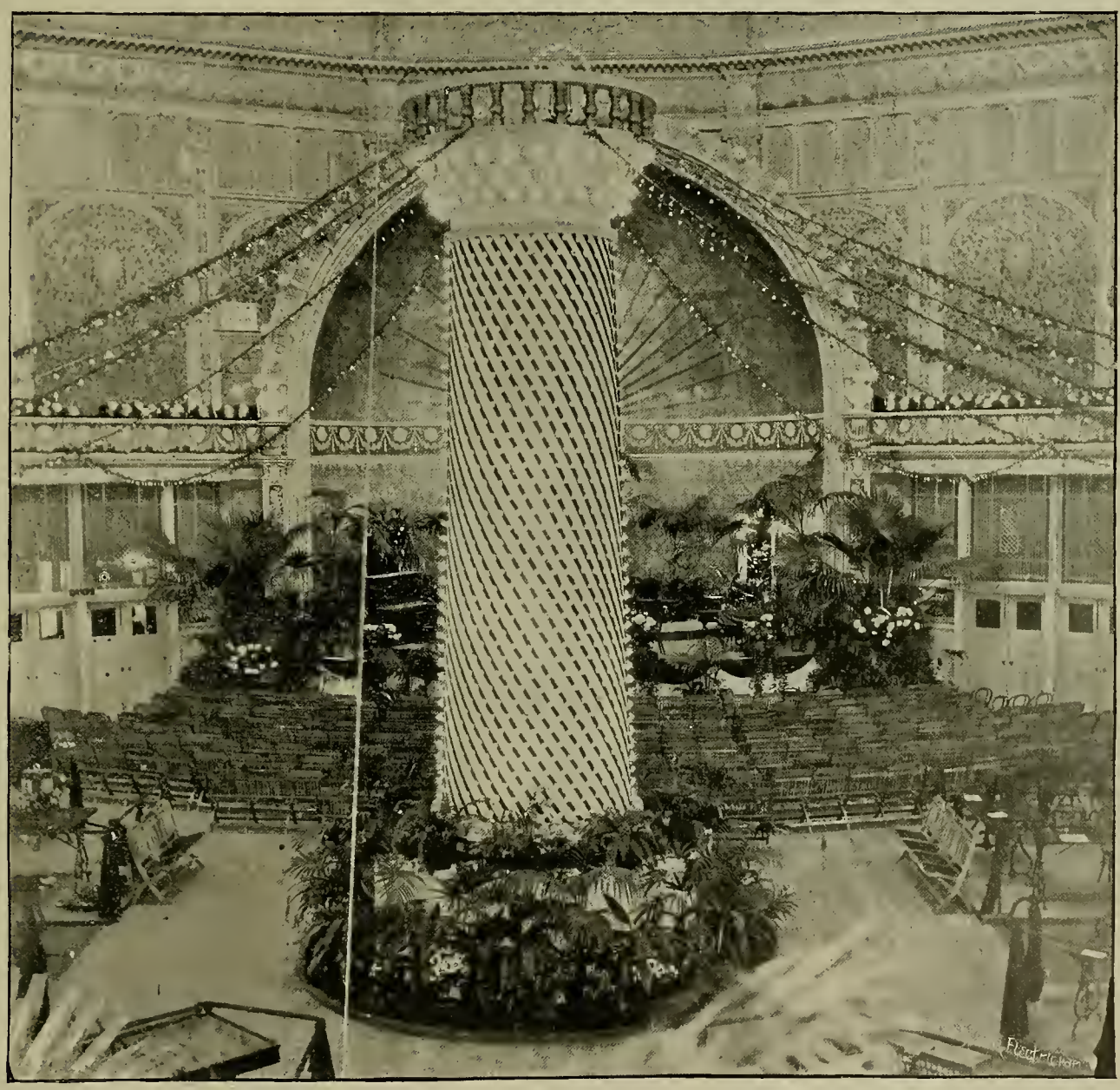


FIG. 1. ELECTRICAL EFFECTS AT THE NEW YORK LENOX LYCEUM—TOWER OF LIGHT.

switches, and at the same time to contacts on a circular commutator switch. One side of these plug switches is connected to a common main, which is bifurcated, one branch leading to the center pin of the commutator switch, and the other to the main cut-out. By closing the switches, all the spiral mouldings may be thrown into circuit, and studded as they are by tiny incandescent lamps of many colors, the effect of their illumination is remarkably brilliant. By removing the plug switches and turning the commutator, each spiral is thrown into the circuit successively. Varying effects of light can be thus obtained, and the spectacle of fiery serpents writhing and winding their way to the top of the column is most realistic, and the shaft itself has the appearance of a block of scintillating marble. The lighting of the festoons is similarly controlled.

A separate dynamo has been set up in an adjoining building for the purpose of supplying current to the tower. Provision has, however, been made to supply current, if necessary, from the street system of the Edison Illuminating company, and for this purpose a change switch of ample capacity has been provided, so that by moving a lever the lamps of the tower and festoons may be thrown at any moment from the 2-wire to the 3-wire system.

In the base of the tower is a bank of lamps which act as a resistance for operating a 50 ampere arc light. This lamp is to be used specially for throwing kaleidoscopic effects on the ceiling for which purpose the tower was primarily designed. While the tower has the appearance of a permanent and solid structure it was erected in one week, and is only of a temporary character. Those who have carried out the innumerable details with such completeness and success are deserving of credit. L. Stieringer was requested by the executive committee of the exchange to take charge of the entire electrical exhibit, and his plans have been most conscientiously carried out by Philip Seubel and his assistants.

Current is taken from the tower on separate leads for operating telegraphic and other instruments on exhibition in the main hall. Prominent among these is a miniature central station, run on the three-wire system. The current operates a two horse power motor belted to two small dynamos, which supply clusters of incandescent lamps. The working of the central station is illustrated in every detail, the plant including switch-board, feeders, junction box and mains, with service attached.

A very picturesque reminiscence of an historical incident is afforded by a life-size figure of Benjamin Franklin, with the traditional kite, drawing lightning from the clouds by means of a key, Fig. 2. This figure stands at the entrance of the hall in a setting of palms, and surrounded as it is by the remarkable inventions which have followed its wake, is full of suggestiveness.

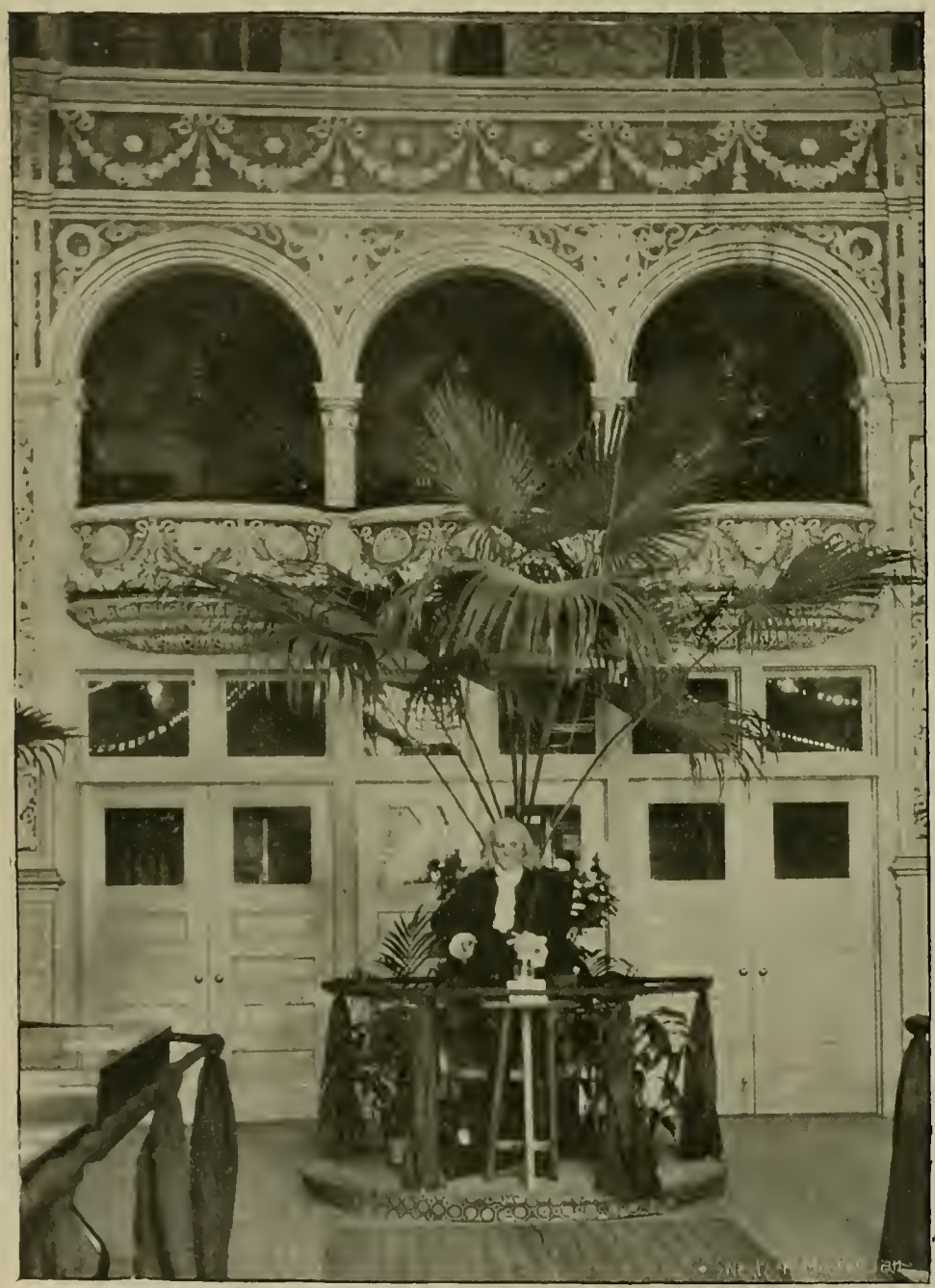


FIG. 2. ELECTRICAL EFFECTS AT THE NEW YORK LENOX LYCEUM—FIGURE OF FRANKLIN.

An extensive electric line is proposed for Vancouver, B. C.

Death of H. A. Glasier.

H. A. Glasier died at his residence, 3024 Prairie avenue, Chicago, Tuesday morning, April 15th. Heart trouble was the cause of his death. Mr. Glasier was born at Johnsburg, N. Y., June 7, 1840. He received a common school education. He pursued his studies, however, after leaving school, and as he was a constant reader, he was well informed on all current topics. He had more than ordinary ability, and was an exceedingly pleasant companion.

During the late war Mr. Glasier served in the Union army. He enlisted as a private early in the struggle, but later formed a company, of which he was made captain, and was assigned to the 64th Massachusetts Volunteers. Mr. Glasier made a creditable showing in the army, and was proud of his record. While ever willing to assist his comrades in arms, he was never connected with the Grand Army or any other similar organization.

Soon after the close of the war he went to California, and engaged in the wool business. He remained there a number of years but finally returned to New York and was made vice-president of the Jarvis Engineering company. For 15 years he was connected with that concern, but recently severed his business relations and established the western agency of J. A. Grant & Co. at Chicago. He removed to this city at that time and had made it his permanent residence. His long association with interests allied to the electrical industry had enabled him to acquire an extensive acquaintance with the representatives of all branches of the business, and, as he was generally esteemed, he was a valuable salesman.

Mr. Glasier's wife and two sons survive him. His death created a profound impression among his associates who had no intimation of any illness. He had complained of feeling unwell Monday, but was at his office attending to business as usual. When he retired at night he appeared improved, but early in the morning aroused his wife and told her he was dying. It was too late to render him any assistance, and he soon expired. He was attended in his last hours by his wife and his friends, M. S. Nicholl and E. H. Britton.

Mr. Glasier was a member of the Chicago Electric club, and when in the city was a regular attendant at its meetings. As soon as the sad news became known a special meeting of the board of managers of the club was called, and a committee was appointed to take such appropriate action in connection with the death as might be deemed advisable. The committee, which consisted of Alex. Kempt, chairman, F. E. Degenhardt, W. A. Kreidler, C. H. Cone and Fred DeLand, was empowered to act for the club. At the request of Mrs. Glasier, the committee made all arrangements for the funeral services on Friday.

Chicago City Telephone Service.

The fire and police electric system of Chicago is undergoing a general overhauling by City Electrician Barrett. This system forms quite an extensive electric plant, and includes telephone, telegraph and signal service for the police and fire departments. A large amount of wire is being put in the conduits, and the system will be materially extended.

Gas and Electric Light.

In the official report of the Ohio Gas association's annual meeting, it appears that much interest was manifested in all papers on electrical subjects, and that these papers occupied a large part of the attention of the members. The first paper read was by George W. Bowers of Hillsboro on "Combination of Gas and Electric Lighting in a Small Town." His experience leads him to very favorable conclusions regarding the advisability of combining these interests. In conclusion he said: "Now, as to the future: We are here and in good shape, with anticipations that our community will take hold of incandescent lighting, to no disadvantage to our private gas consumption; as it is known the country over that where one place of business is well lighted the next door neighbor must have a better light, either with gas or electricity, and thus we hope to increase either one or the other of our modes of lighting. In regard to the people of smaller towns, it generally takes some time to get them interested in any matter of this kind; but we intend to treat them liberally, and hope by next year to give a successful account of a paying investment of the arc and incandescent addition to gas which makes a success of "Combination of Gas and Electricity in a Small Town.'"

Electrical Scenic Effects at the Chicago Auditorium.

Many of those who witnessed the performance at the Chicago Auditorium during the season of grand opera, wondered at the brilliant and startling scenic effects. Of the great majority of the spectators who felt a curiosity as to the manner in which these effects were produced, there were doubtless few who realized how many were the result of the skillful use of the electric current, and how simple was the apparatus employed. The following description of the devices was obtained through the courtesy of Milward Adams, manager of the Auditorium:

Most of the electrical effects, with the exception of those obtained through the use of the ordinary incandescent lamp, were produced by the manipulation of apparatus manufactured in Dresden by Hugo Bahr and imported especially for use in Chicago's great theater. With the assistance of the accompanying diagrams from which all unnecessary details have been eliminated, little difficulty will be found in understanding the action of the simple mechanism.

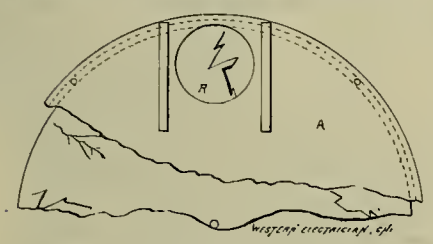


FIG. 3. ELECTRICAL SCENIC EFFECTS AT THE CHICAGO AUDITORIUM.

It is surprising how great a variety of effects can be obtained by the skillful manipulation of the electrically lighted stereopticon. On account of the great breadth of the Auditorium stage a most realistic effect can be secured in the representation of the sky and sea. Lightning effects, storm and other cloud effects of almost infinite variety, waves and ripples on the water, and even the conventional representation of a dream or vision—all these and many additional brilliant effects can be conveniently produced by the aid of the electric light and stereopticon, which is nothing more or less than an improved magic lantern.

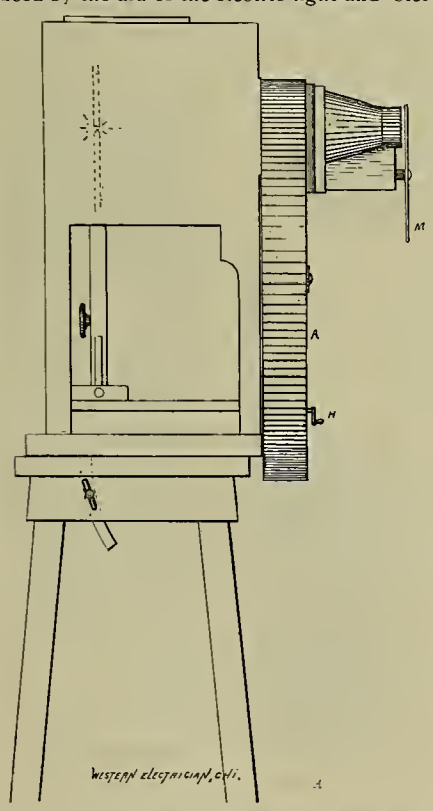


FIG. 1. ELECTRICAL SCENIC EFFECTS AT THE CHICAGO AUDITORIUM.

In Figs. 1 and 2 the stereopticon is represented as it appears when arranged to throw a lightning flash upon the sky background. Referring to the cuts it will be seen that the instrument contains an arc lamp and there is attached to it, as shown, a circular shaped case or box *A*. The arc lamp, it may be mentioned, is hand-regulated and is supplied with current from the incandescent plant in the building.

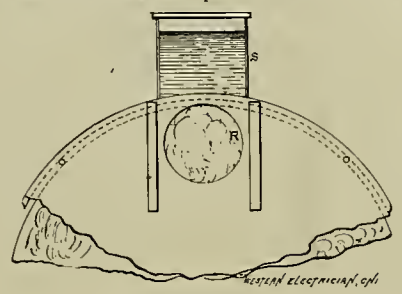


FIG. 4. ELECTRICAL SCENIC EFFECTS AT THE CHICAGO AUDITORIUM.

The box *A* contains a circular glass plate which can be revolved by means of a small handle at *H*. Upon this plate are miniature representations of the lightning flash—in other words, there are on the plate a number of flashes, each so to speak, of a different type. This construction is represented in Fig. 3, which shows the case and plate carrying the slides. These slides, each representing a flash, might be described as photographic "positives," in that, when one is held between the eye and the light, the line of the flash appears as clear glass while the surrounding surface is opaque. When a slide is revolved by means of the handle *H* into position in the instrument, that one particular flash may be projected upon the canvas. In order that the representation may be instantaneous and at the same time that the flash may have a quivering or vibratory effect which is characteristic of lightning, it is necessary to bring into service another attachment. This is represented in Figs. 1 and 2 at *M*, and is simply a disk, with three openings of different sizes, which is hung in front of the lenses. When it is desired to throw the flash, the operator gives the disk a twirl and catches it after one revolution. By this movement a flash is produced which disappears in an instant. The disk *M* is of course only required in the production of lightning. In producing cloud effects a case or box, Fig. 4, similar to box *A*, is attached to the stereopticon. The opening, *R*, is of course in line with the arc light and lenses of the instrument. The glass disk or plate in this box carries the several cloud "slides." By revolving this disk, therefore, and manipulating the tinted slide *S*, not only can clouds be projected, but these at the same time may be made to vary in appearance, changing both form and color. The appearance of rippling water is secured in much the same manner. The case then contains three slides, all of which are in line with the lenses. Each of these slides is painted with undulating black lines, and is moved past the opening *R* at the same time and at a different rate of speed from the others. Where moonlight on the sea is represented, this ripple effect is most striking.

FIG. 5. ELECTRICAL SCENIC EEFECTS AT THE CHICAGO AUDITORIUM.

The device for representing the moon is shown in Figs. 5 and 6. It is a most simple apparatus. Its diameter is about 24 inches. It consists of a face of thin porcelain or a similar translucent substance behind which are arranged, as shown, six incandescent lamps. Three globes are colored red, and three are of frosted glass. They are arranged alternately. By the manipulation of a resistance box any desired intensity of light may be secured, in either or both sets of lamps. For instance, the full moon as it rises above the horizon has a reddish glow which gradually changes to a silvery hue as it approaches the zenith. This effect is produced by manipulating the resistance so as gradually to lower the red lamps and brighten the white. The six lamps, shown in Fig. 5, are mounted on a central socket which is carried by the base board at the back, which is covered around the lamps by a rough coating of tin foil. The resistance box is small enough to be carried about, and is fitted with a reel from which the conducting wires are paid out to the lamps in the moon. Where a moon of unusual brightness is desired a face similar to *C*, Fig. 5, is used in combination with an arc lamp and a parabolic reflector.

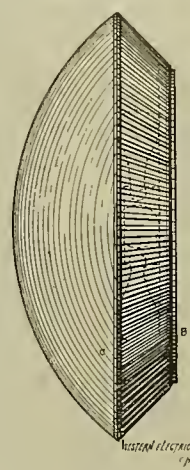


FIG. 6. ELECTRICAL SCENIC EFFECTS AT THE CHICAGO AUDITORIUM.

A curious piece of apparatus is represented in Fig. 7. It would be difficult to imagine the use of this device from its appearance. As represented in the cut it is considerably smaller than in reality. By its use the fire-fly effect is produced. Quite a number of these devices are located in various positions among the trees, in the

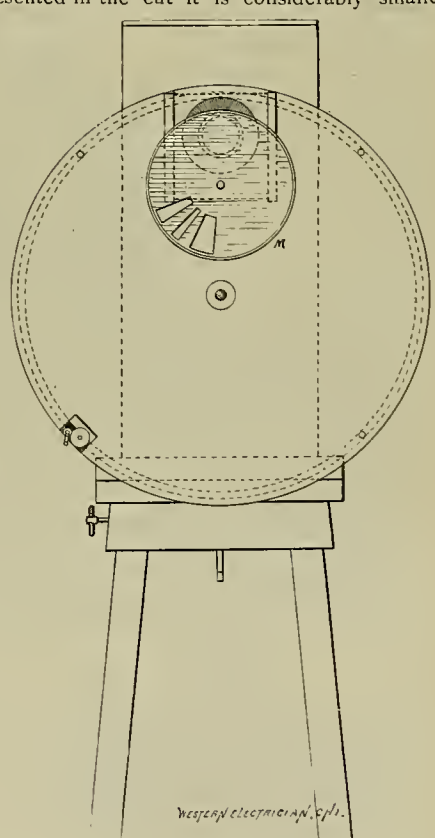


FIG 2. ELECTRICAL SCENIC EFFECTS AT THE CHICAGO AUDITORIUM.

foliage, etc. Each device represents one fire-fly and is connected by small copper wires, with what might be described as a commutator. By moving an arm over the contact blocks of the commutator, the operator can at will cause the "bug" to flash. The action of the device may easily be understood after a glance at the cut. The moment the current passes through the two carbon points it energizes the electro-magnet. This immediately pulls down the armature and breaks the arc between the carbons. In working the fire-flies it is necessary to use resistance in circuit in order to secure a proper adjustment.

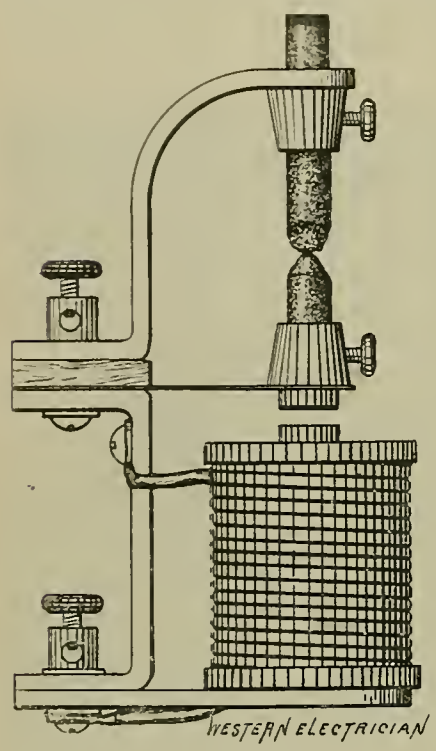


FIG. 7. ELECTRICAL SCENIC EFFECTS AT THE CHICAGO AUDITORIUM.

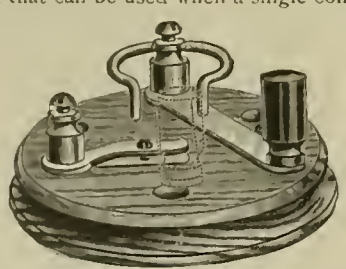
In addition to the effects obtained by the use of the apparatus described, a number of others may be worked out by the skillful electrician in charge. For example, where it is desired to produce, without a distinct and marked flash, that peculiar quivering glow which is characteristic of the so-called heat lightning, the electrician draws an arc or flash by making and breaking contact between, preferably, an old rasp or file and a heavy copper wire connected in circuit with the necessary resistance.

In the opera of "Faust," Mephistopheles draws, with the point of his sword, a circle of fire. The manner in which this effect is produced will suggest itself: Sets of thin metal plate are attached to the floor and represent + and — terminals on the incandescent circuit. A metallic connection is made from the soles of the actor's shoes to his sword. By standing on one set the circle of flame can be drawn by the movement of the sword point across the other set.

For information as to these details the WESTERN ELECTRICIAN is indebted to J. J. Fanning, electrician of the Auditorium.

Single Contact Switch.

The accompanying cut illustrates a simple switch that can be used when a single contact is needed, but where the necessities of the case do not justify the use of an expensive device. The dotted lines show the switch closed. In this position the arm is forced between two straps of brass, giving a large surface contact on both sides of the arm. The spring at the back holds the arm away from the contacts when the switch is opened, so that there is no danger of an accidental contact. The switch is placed on the market by the Central Electric company of Chicago.



SINGLE CONTACT SWITCH.

Victory for Saginaw Electric Road.

The Union Street Railway company of Saginaw, Mich., has just secured an important victory in an injunction proceeding brought by two property owners who opposed the operation of an electric road in front of their property. In addition to the usual claims that the system would be dangerous to life and property, and that the city officials had no right to grant the company permission to substitute electricity for horses in the operation of its lines, the complainants raised this point:

Whether in the event the railway shall be found authorized to make use of electricity as a motive power, its occupancy of the street for the laying of its tracks, setting up its poles, stretching of its wires and operation of its cars, is foreign to the uses to which the public thoroughfare may be properly subjected by the municipal authorities without the consent of or compensation to the owners of adjacent property.

The case was decided April 11, when the petition was dismissed. The accompanying abstract is from the opinion filed with the decision:

We find the legislature, by an amendment to the train railway act, contemplated and authorized street railways then existing to use steam, animal or other motive power, if municipal authority should sanction its use. The legislature may not have heard of electricity as a motive power, but they evidently contemplated that other motive power than steam or animals might come into use. It is contended by complainant's counsel that only animal power was intended. We cannot agree with this construction. It is not pretended that the railway can be put to any use, either under its incorporation or under the grant of the common council other than the transportation of passengers within the limits of the street. It is essentially for all purposes the street railway to which we have been accustomed ever since the passage of the act of incorporation in 1867, except that electricity instead of animals is to be used as a motive power. The grant made by the common council of the city of Saginaw is full and explicit upon the use of the electric system by this railway defendant, and includes by specific enumeration the right to set poles, stretch wires and maintain the other fixtures requisite to the operation of its road, and we are therefore of the opinion that so far as the right to make use of the motive power of electricity is concerned, the question cannot be raised.

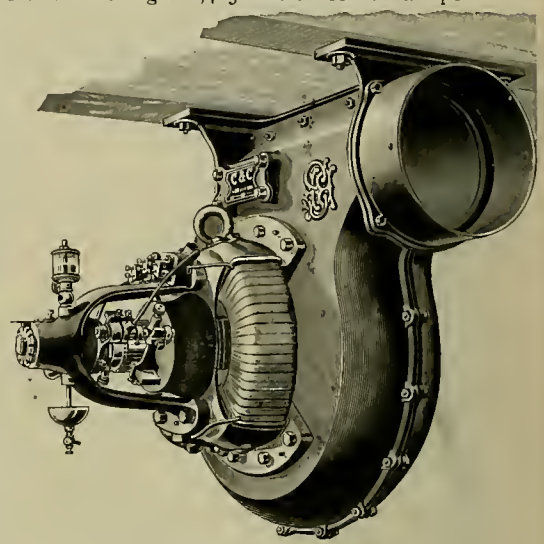
Judges Gage and Edget reviewed the case and prepared the opinion. L. T. and C. A. Durand were attorneys for the electric road, and Wisner & Draper counsel.

Fast Telegraphing Tournament.

The Fast Telegraphing Tournament at New York last week was an interesting contest, and was watched by many prominent men who began life at the key and advanced to more responsible positions. The first number on the programme was the lady's contest. The best score was made by Miss Kittie B Stephenson of the Western Union company of New York, who made the creditable record of 217 words, 2,436 ticks, in five minutes, and secured as her reward $50. A number of special prizes were also handed this lady. Miss T. V. Freschel was awarded the United Press prize of $25 for the best seeding, speed and quality both considered. This prize was duplicated by John J. Sabine, an old timer at 'Frisco, who had sent on a check for $25 to accompany the U. P.'s award. In the Old Timers' class "Patsy" Ayres took first money, $50, and also the special $25 for best sending. The second prize of $40 was awarded Fred Catlin. In the free-for-all there were 14 entries, and as many of the fastest senders in the country were included in the number, it was expected that a man of some reputation would be the winner. To the surprise of all, a "countryman" named B. R. Pollock, who had come over from Connecticut without any flourish of trumpets, scored 258 words. The old timers were astounded and declared that Pollock didn't seed good Morse. One of the judges was absent during this exhibition, and the other four were not of one mind, so it was decided to have another trial in which Catlin, Soloson, Pollock and Gibson alone should compete. "The time of Catlin and Soloson," they said, "was phenomenal, and that of Pollock ahead of all records, but the manipulation has been imperfect." Pollock was the first one to renew the trial, and he even surpassed his first attempt, sending 260 words in five minutes, two more than his previous record. The "cracks" could say nothing more, and they looked on despairingly while one by one Pollock's competitors failed to surpass or even equal his truly remarkable record. The judges delayed the decision until nearly 1 o'clock next morning, but then they finally decided that Pollock would have to be recognized even if he were a countryman, and gave him first prize. The second prize went to Mr. Gibson and the third to F. J. Kihm. W. L. Waugh took the United Press prize for best sending in this class. In class B, F. L. Catlin sent 251 words and 1 character in the specified time, the best on record, saving Pollock's. The prizes went: First, $85, F. L. Catlin; second, $65, W. L. Waugh; third, $30, Frank English; special prize for best sending, $25, J. P. Bradt. It is expected that many contests will be arranged within a short time, as the 'city cracks" will not rest content until they have another opportunity to try their skill against Pollock. The latter, after performing his phenomenal feat, returned to his railroad office, and continued at his post.

Electric Blower.

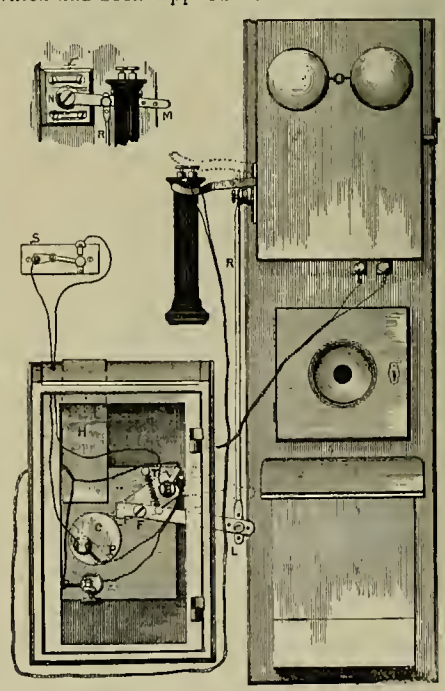
The cut which is presented herewith gives a view of a C. & C. electric blower, which is in use on the United States cruiser Baltimore. The blower discharges 1,425 cubic feet of air per minute. Fastened to the ceiling of the dynamo room it completely changes the air of the room, it is claimed, once every two minutes, discharging it at a distant point through a pipe. The entire machine is compact, and it takes up no space that could be used for anything else; it does its work so noiselessly, it is stated, that a person standing near cannot tell without the closest observation whether it is running or not. The blower is manufactured by the C. & C. Electric Motor company, New York.



ELECTRIC BLOWER.

New Telephone Toll-Box.

In a recent issue of the WESTERN ELECTRICIAN there was presented an illustrated description of an automatic telephone toll-collector, which had been applied to a number of telephones in Chicago. Where this device is in service, those who wish to use the telephone have first, to drop a dime in the slot, and then lift a shutter which covers the mouthpiece of the transmitter. In the apparatus here described, the coin which is dropped into the slot serves to form a portion of the circuit to the receiving instrument. The details of the appa-



NEW TELEPHONE TOLL-BOX.

ratus will be understood by reference to the cut. The toll-box complete is shown to the left. A side view of the rigging at the telephone suspension-hook is presented in the upper left-hand corner The lettered parts in the box are as follows: *H* is a chute which depends from the slot opening through the top of the box. Just below the lower end of the chute is fixed an inclined rest or stop. This is of metal, and is indicated by the dotted line. To the outer side of the inclined stop is attached the coin guard-plate *P*. Near the stop is arranged the short end of the lever *L*. This lever is pivoted at *F*, and extends through the box connecting, as shown, with the rod *R*. The rigging at the upper end of rod *R*, as was before stated, is represented more clearly in the side view in the upper left-hand corner of the illustration.

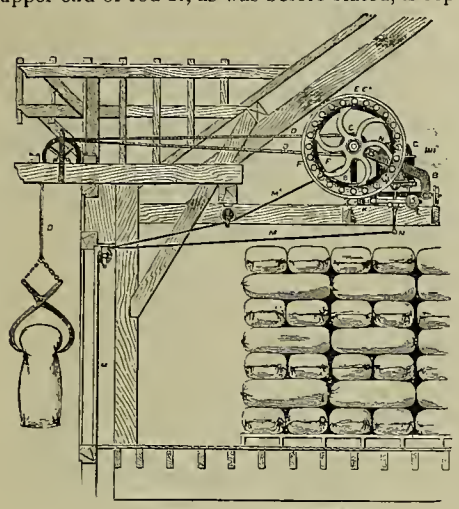


FIG. 2. FRENCH ELECTRIC HOISTS.

The operation of the device is as follows: It will be understood that the toll-box is interposed in the length of the flexible cord leading from the telephone-box to the receiver. This double cord from the telephone-box comes in one side of the toll-box, is connected, as shown, and goes out the other side of the case to the receiving telephone. Now when the receiver is taken off the suspension-hook and the outer end of lever *M* rises, as shown by dotted lines, the lever arm *L* also rises in response to the spiral spring *T*, and the inner end of lever *L* is thrown down toward the coin-rest. The instrument is now in condition for operation, except that the circuit of the receiver is broken. This is closed by dropping a coin or its equivalent in the slot. This coin *C* descending the chute, falls upon the inclined rest, and is prevented from falling outwardly by the guard-plate *P*, and is prevented from dropping down by the inner end of lever *L*. The coin in this position establishes connection between the broken ends of the receiver cord and brings the telephone into operative condition. When the receiver is hung up after use, the descent of the suspension-hook forces down arm *M* and lever *L*, and the inner end of the latter in rising releases the coin, dropping it into the box and breaking connection again between the sections of the receiver circuit.

It may sometimes happen that after a customer has deposited his coin he may not be able to get the use of the line on account of its occupation by another subscriber. In that case, the customer reports the fact to the owner of the office or store, and the latter is enabled to give his customer the use of the line by a private shunt circuit and switch without depositing any further pay. For this purpose two wires extend, respectively, from the coin-rest and the lever-plate to a switch *S*, located at a distance, or out of the observation of the customer, and the proprietor, by closing this switch, can at will close the receiver circuit independently of the deposit of a coin.

This device is the invention of H. L. Cassard of Baltimore, Md.

Chicago's Quotations.

The fight between the Chicago Board of Trade and the bucket shops continued last week, and the latter managed to secure quotations despite the utmost vigilance of the board of managers. These gentlemen had ordered quotations suspended, and had also taken precautions to have the tickers removed from the floor. This did not have the desired effect and the managers began to impose restrictions which it is asserted they have no legal authority to enforce. If a member disobeys the rules framed by the managers he is liable to suspension, and as there is no redress under the present system of organization the members are coerced into obedience. It is evident, however, that a submissive policy is not contemplated by many of the members. One of the regulations the board adopted last week was the ordering of the doors locked, with the exception of one which was closely guarded, to prevent messenger boys from carrying quotations to brokers' offices. This resulted in arousing the indignation of a wealthy member who broke the huge plate glass in one the doors and then unfastened it. The managers have ordered the telephones in the offices of the building cut out during the board's hours of business. This of course they cannot enforce if the members desire to rebel. It is probable an attempt will be made to discontinue private wires, but this will have the effect of provoking an immediate war between the managers and many of the most influential members of the board, and the managers hesitate about provoking this rupture. On the whole, the high handed policy adopted by the board has done much to provoke resentment on the part of the members, and it is possible that they may overtax the members with restrictions.

French Electric Hoists.

At the Paris exposition a number of electric hoists were exhibited by M. Guyenet. A general idea of the method of operating the several kinds of hoists may be gained by an inspection of Fig. 1. In this case the iron base of the machine rests upon four wheels so that the apparatus may be easily moved along the track. The motor which is of the Gramme type is supported upon a frame pivoted at the base of the machine as shown in the cut. The main shaft of the hoist carries a drum on which the two lifting cables are wound. One cable uncoils as the other is wound. This shaft is also provided at each end with a large friction wheel. These two wheels are cast, as indicated in the illustration, each with what might be described as a groove at the inner side of the rim. The motor spindle carries two friction rollers, one at each end, and these revolve within the grooves in the large wheels. The lever and rigging at the side operate to swing the motor on its pivot at the base, throw the rollers against either one side or the other of the groove, and at the same time unlock a wedge brake. Thus by pressing the lever in one direction or the other the large friction wheel and the drum is revolved to the right or left, as the case may be, and one lifting cable rises as far as the other descends. When the pressure on the lever ceases, the brake locks itself automatically, and the load at the other end of the cable remains suspended wherever it happens to be. The motor of the hoist shown in Fig. 1, has a capacity of about four horse power and is built to revolve in one direction at a speed of 1,200 revolutions per minute. Movable cranes constructed in the same general way have been built by M. Guyenet for transferring goods in warehouses and for work on the docks. Fig. 2 shows the hoist as ordinarily used in a warehouse, that is, located on heavy beams at the top of the building. In this case the ropes *M M'* are used for controlling the operation of the hoist. As in the previous case the brake is applied automatically. Fig. 3 shows an application of a machine of this kind used in warehouses for piling up sacks. In this case a counter-balance is used. The general operation of the motor and lifting mechanism is the same as in the two previous cases.

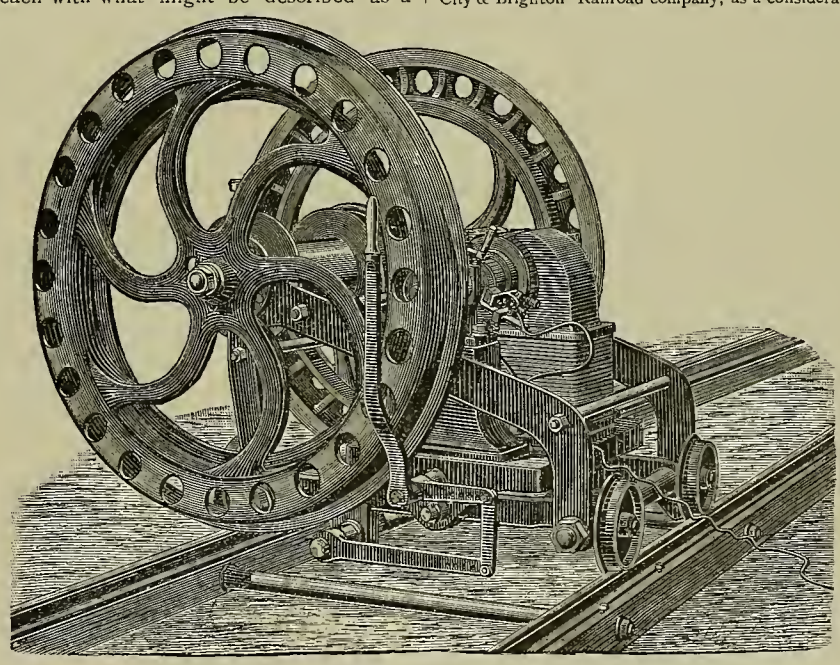


FIG. 1. FRENCH ELECTRIC HOISTS.

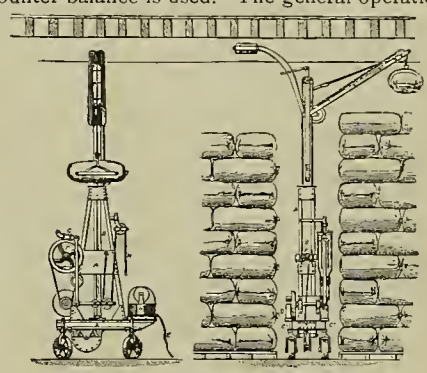


FIG. 3. FRENCH ELECTRIC HOISTS.

For the illustrations of these hoists we are indebted to the *Revue Internationale de l'Electricite.*

Rochester's Electric Railway System.

The Rochester, N. Y., Electric Railway company is pushing its work of construction rapidly. It has asked the Brush, Rochester and Edison companies to furnish estimates for supplying power. Messrs. McTighe, Barry and Brown are the experts for the road. Speaking of the improvements during the year, the retiring mayor of the city said in his last official communication to the common council: "The greatest achievement of the year, however, is the agreement obtained by the city from the Rochester City & Brighton Railroad company, as a consideration for the granting of a franchise to that corporation for the change of motive power from that now in use to the propulsion of its cars by electricity In pursuance of that agreement the tracks of the company will be extended and multiplied, the bob-tail vehicle superseded by cars of comfortable proportions in charge of conductors, which cars will traverse, by rapid transit, the principal streets from the business centers to the furthermost limits of the city. By means of that franchise and the conditions under which the grant was made, people living in the outskirts will be enabled to go to and from their places of business with no appreciable loss of time and without the payment of several fares for one continuous ride. The outlying property of citizens will be greatly enhanced in value, and the benefits which will accrue to the people in this and other ways will exceed, I dare say, even your present sanguine expectations."

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - Associate Editors.
A. C. DURHOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 125 TEMPLE COURT, NEW YORK.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE plan for utilizing the power of the Mississippi river at Minneapolis for the generation of electricity, a scheme of which so much has been written recently, has been abandoned. It has been found that the use of water power would involve so large expense that its utilization would not be economical.

THE death of H. A. Glasier of Chicago, which is announced in another column, occasioned genuine sorrow in electrical circles in Chicago. Mr. Glasier was widely known in the electrical world and was highly esteemed. Always courteous and kindly, he possessed hosts of friends in all parts of the country.

THE latest development in the line of a nickel-in-the-slot machine is a telephone toll-collector. This device can be applied to any ordinary telephone set. Its novel feature consists in an arrangement of parts so that the circuit to the receiver is completed through the coin itself. As this is the simplest and most ingenious machine of the kind which has yet been brought to our notice, a full description of the details is given in another column.

STANLEY, the explorer, according to a cablegram, was induced by a reporter at Brindisi to make a statement which he declared he had intended to save for publication in his book. The Aruwhimi forest, he remarked, which belongs to the Congo Free State, was enormously richer in everything, especially in rubber trees, than the Amazon forests. This section of Africa, he declared, would furnish the world with all the rubber which it needed. This item of news will be unpleasant reading for the organizers of the rubber trust.

IN several of the recent papers predicting the use of electric motors in general railway work, it has been stated that an economy could be effected at certain times when the motors could be employed as generators, and thus give back power to the line. The subject was referred to in a recent Boston letter, which gave the results of practical experiments. On a storage battery line it was found practicable to use the motors as generators when the cars were descending hills, and in this way to charge the cells. It was stated that 10 per cent. was added to the original charge by this means.

THE average theater-goer in Chicago would doubtless be surprised to learn the extent to which electricity is used in producing scenic effects at the Auditorium. That electricity is a wonderful agent all are willing to admit, but a complexity of apparatus is usually associated with its application. In producing various brilliant effects, however, in Chicago's great theater, the apparatus employed is extremely simple. In an illustrated article, presented elsewhere in this issue, a number of the devices are described. Those of our readers who have not made a study of the subject will, in all probability, be surprised at the great variety of effects which may be produced by a single device.

THE high handed policy adopted by the Board of Trade of Chicago in its fight against the bucket shops has provoked considerable unfavorable comment. The last action of the managers was to order a discontinuance of the use of telephones in offices of the building during the hours when the board is in operation. This is intended as a check on the members who have been furnishing quotations to the outside brokers. A proposition has been made to discontinue the private wires of members, but should an effort be made to enforce this it is prophesied that it undoubtedly would lead to an open declaration of hostilities by many of the most influential members who have heretofore quietly submitted to the severe restrictions already imposed.

THE news has been received that the operation of the storage battery cars which have been run in Brussels for the last four years is to be discontinued May 1. The company which has operated the cars states that it has come to the conclusion that the system was not economical. The company has been severely criticized by the Brussels press, which asserts that there was no necessity for abandoning the system. The conditions under which the cars were operated were particularly unfavorable. The capacity of the cars was small, and the gradients on the line were by no means easy. Moreover, although only three cars were provided, the station was arranged with machinery sufficient for working eight cars, and this in itself was a disadvantage, since the general expenses of eight cars would be about the same as when only three were employed.

THE construction of extensive systems of railways in Boston, St. Louis, Minneapolis and St. Paul, Milwaukee and other cities, has awakened general interest, and it is suggested that the cross town lines of Chicago might be operated to advantage in the same way. The opposition to aerial wires in the down town districts would make it impracticable to operate by electricity through the principal business streets by the overhead system, but there is no apparent reason why overhead systems could not be operated on Twenty-sixth, Thirty-first, Thirty-ninth and Forty-third streets on the South Side. These lines are not at great distances from the several cable power houses, so that power would be available. It is questionable, however, whether it would be profitable to the companies to substitute electric motors for horses on the cross town lines mentioned, inasmuch as few cars are operated, and their trips are few and far between.

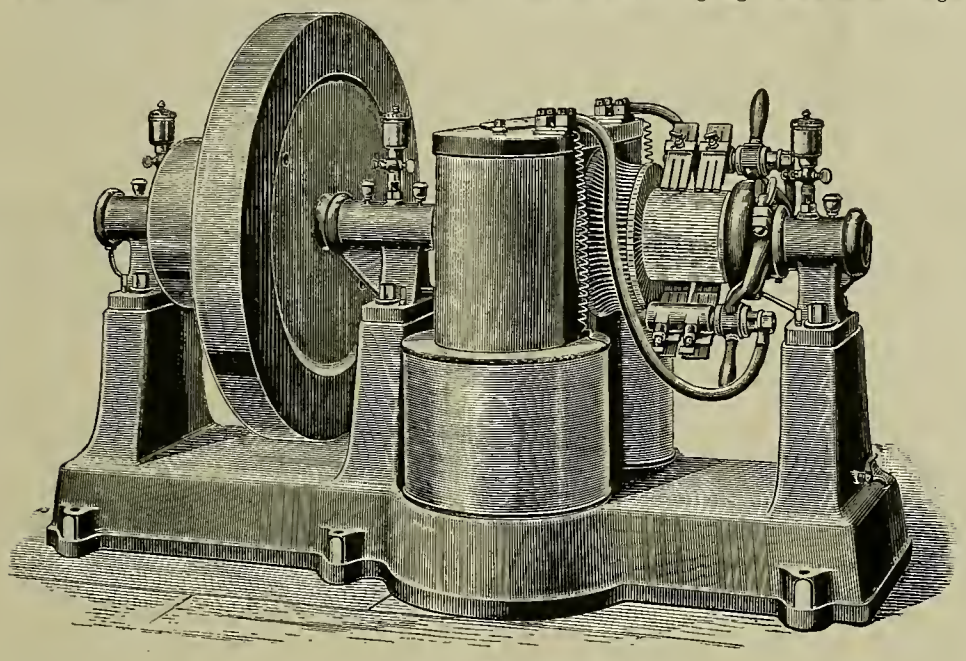
THE question whether the tractive power of an electric locomotive is increased by passing the current between the car wheel and rail, is one which has awakened considerable interest. It will be remembered that Leo Daft performed a number of experiments in connection with his work on the elevated roads in New York, which appeared to substantiate the theory that the adhesion coefficient was materially increased. More recent experiments by others, however, fail to sustain this view. Indeed, in a recent account of experiments performed with a car on the Brooklyn & Jamaica Electric railway, it was asserted that the difference of adhesion caused by the passage of the current, if any, was hardly worth considering. Undoubtedly this peculiar effect, if existent to any considerable extent, would have a most important bearing in a number of the problems involved in an application of the electric system to a steam railroad. In an article in another column, entitled "The Problem of Substituting Electricity for Steam," we are brought face to face with a few difficulties relative to the point above referred to, which will have to be provided for. Attention is called to the fact that, after all, there have been no tests, as far as is known, which may be referred to as conclusive evidence that the gain from this peculiar effect will be sufficiently great to compensate for the necessary relative lightness of the electric locomotive due to the absence of a boiler and furnace. The importance of weight on the drivers, so fully realized and appreciated by designers of steam locomotives, is dwelt upon, and the writer concludes that electrical engineers will have to give a thoroughly practical demonstration of the correctness of their assumptions before conservative steam railroad men will consent to a consideration of the abandonment of the present ideal unit power system.

THE dispatches keep us informed of the fact that "preparations for the execution of Kemmler by means of electricity are progressing," at Auburn prison. What is being done by way of preparation it is hard to conjecture, inasmuch as all the death-dealing apparatus was completed and connected up some weeks ago. The officials now maintain a mysterious silence in regard to the nature of these preliminaries. It is understood, however, that the "preparations" consist in the frequent consultations of authorities in regard to the admission of witnesses to the execution. The greatest pressure has been brought to bear upon the officials, yet by law they are compelled to limit the attendance. It is now stated that the Auburn officials have determined that representatives of the press shall have an opportunity to witness the execution. Reporters of two press associations are to be admitted, but if they publish any account of the execution they must violate that provision of the law which states that no mention of an execution, beyond the mere statement that it took place, shall be printed by any paper. Of course, it is well understood that reporters, if admitted at all, will be allowed the privilege for the simple purpose of writing details. To give them an opportunity to witness an execution, as the officials propose to do, and then say if they publish any details they do so at their own peril, seems very much like aiding and abetting persons to do an unlawful act. It is interesting in this connection to notice that the Iowa assembly recently repudiated a bill providing for electrical executions. The legislators determined to await the result of the experiment in New York state before committing the state to the same uncertain method of inflicting the death penalty.

In regard to the admission of press representatives, the New York *Sun* says: "If the people of this state really believed that the existing statute would prevent them from learning how the new system of electrical execution works, the popular demand for its repeal would be such that the legislature would change the law within a week. As it is, however, we already find the state authorities who are to supervise the final execution, adopting a course which is admirably calculated to render utterly ineffectual the provision against any disclosure of the details through the press. It is not pleasant to see officers thus assist in the evasion of a statute, even though it may eventually be held to be unconstitutional. The right way is to strike the law from the statute book forthwith."

New English Dynamo.

The accompanying cut represents a dynamo built by Charlesworth, Hall & Co. of Oldham, England. This machine was designed especially for service with a gas engine. As will be noticed from the cut the dynamo is constructed most substantially, and the bed-plate has been extended to support the extra weight of a fly wheel, which is thirty inches in diameter and weighs about six hundred pounds. This wheel is strengthened by a wrought iron hoop which is shrunk around it. The main shaft of the machine is of hard steel, and is two inches in diameter in the bearings at the pulley end, and 1⅞ inches at the other end. The bearings are of aluminium bronze, each eight inches long. The pulley is thirteen inches in diameter, and carries an eight-inch belt. While there appears to be little that is novel in the electrical portion of the dynamo, a few of the more important details are given as follows: The magnet cores are of soft charcoal iron. The pole pieces are in one forging with the magnet cores. The armature frame is of aluminium brass. The core, which is twelve inches in diameter, is built up of soft charcoal iron disks, and has an area of 40.5 square inches. The commutator has eighty segments of hard drawn copper, and is insulated entirely with mica. The armature is wound with 200 convolutions of wire, No. 8 B. W. G., and has a resistance of .045 ohm. The magnet is shunt wound in that type of machine, which is used for charging accumulators, and has a total resistance of 31.6 ohms. When supplying lamps the normal load is 150 amperes and 100 volts at 670 revolutions per minute.



NEW ENGLISH DYNAMO.

Death of Johann Georg Halske.

The death is recorded at Berlin of Herr Johann Georg Halske, the co-founder and for many years partner of the well-known firm of Siemens & Halske. He was born at Hamburg on July 30, 1814, and went to Berlin, where he set up an engineers' shop in 1844. Soon after he made the acquaintance of Werner Siemens, and it was in Halske's workshop that Werner Siemens, assisted by the mechanical skill of the former, was able to work out his first inventions in telegraphy so as to bring them before the public. In 1847 the two men entered into partnership, and laid the foundation of the electrical works which at the present day give employment to thousands of workmen both at Berlin and Charlottenburg, and at several branch establishments. Herr Halske left the firm in 1867, and since then has been an active member of the municipality of Berlin.

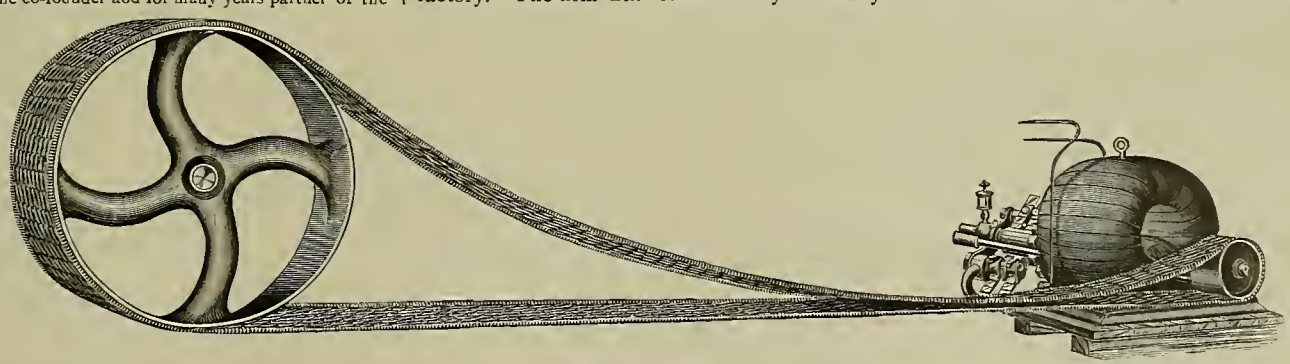
Electric Light Asserting Its Superiority Over Gas.

Among the papers read at the Ohio Convention of Gas companies at Toledo, was an interesting address by Charles R. Faber, Jr., superintendent of the Gas Light & Coke company of that city. He called attention to the rapid increase in the electric lighting business and said the gas companies should not be content to stand still and see their rivals push ahead of them, and show a very large increase of lighting business in the same territory the gas companies have so long occupied. He concluded his remarks with the following pertinent questions: "If electric light companies offer a light that answers the purpose better than gas, then we must look for another market for our product. If, to secure business, they make generous concessions to very large consumers of light, then, if we can afford to do so, we also should be prepared to make like concessions and secure the business. If a large and profitable increase of business is not to be secured to us in the field of lighting, then is not the fuel and power field the one for us to occupy? And is not the present the time for us to make the necessary move to secure the same?"

Wire Link Belt.

An interesting installation of wire link belt can be seen at the factory of George Kelly & Co., manufacturers of wire goods, Chicago. On the third floor of the building long lines of shafting have been put up and here the advantages of the wire link belt are demonstrated. All sizes of this belt can be seen in actual operation at the factory, and it is used for almost every conceivable purpose and in every manner. From the accompanying cut a general idea of the appearance of the belt can be gained. It shows an Eddy motor, belted up as it is in the factory. The firm utilizes electricity in many ways in its factory, and this gives it an opportunity to show how a wire link belt can be used in electrical work. The advantages claimed by the makers for this wire link belting are, durability, flexibility, and economy. It is formed of spiral wire links, which are made flat, from one inch to three inches wide, coupled together with steel rods. These rods work in horizontal sockets running parallel with the rod, making the link a perfect hinge. The wire used in these links ranges from No. 8 to No. 12, giving the desired strength, and the belt is capable of being run perpendicularly, horizontally and twisted, quarter, half or three-quarter turn. Belts in all these positions may be seen in operation in the factory. No trouble is experienced in extending or shortening a belt according to the requirements incidental to shifting machinery.

The manufacturers say that their experience and that of their patrons warrant them in saying that this belt is not affected by heat, and that no trouble is experienced when it is run out of doors. It may be galvanized for this work or may be plated with nickel, brass or copper.



NEW LINK BELT.

The Problem of Substituting Electricity for Steam.

By Practique.

Of late a number of articles have appeared in the electrical journals on the subject of the application of electricity to general railway work. There seems to be a concensus of opinion among authorities that the electric motor as a train mover will ultimately supersede the steam engine. As a consequence there has arisen considerable discussion as to the more important details of a large and extended system. From data obtained through experience with the more successful of American street railways, our best-informed electrical engineers have been enabled to map out what, in all probability, will be the railway of the future. It is generally conceded that the "station-along-the-route system" is the one which seems the most feasible and practicable. If, then, we may predict the adoption of such a system of electric motive power, how may we look for the change to be effected on roads already equipped with steam locomotives? Up to the present time it has been a question between animal power and the electric motor. The substitution of an electric system of power transmission on an American steam road means something more. The street railway company builds its power station, strings an overhead wire, equips each car with motors, and goes ahead—result, a large sale of horses with but little loss, and satisfaction for all parties concerned. The equipment of the steam road must be considered from another point of view. Here we find a system already ideal to the extent of its operation with units of power. Each train goes out equipped, if it may be so expressed, with its own power station, fuel generator, motor—all in one. Advocates of the station-along-the-route system, in considering the details of the problem, find themselves confronted also with a number of difficulties of a mechanical nature. These will all have to be surmounted.

The question is raised as to the tractive power of the electric locomotive. It is hardly to be supposed that electric motors will ever be generally applied to the axles of the cars on a steam road. The tendency even at the present time on the street railway is in the direction of an equipment with electric locomotives in preference to motors beneath each car. If such is to be the practice—and it seems reasonable to suppose that it will—must not the relative lightness of an electric locomotive as compared with the steam locomotive be taken into consideration? Much has been written and said concerning an increased tractive power caused by the

passage of the current between the car-wheel and rail. Experiments have been made which, it is claimed, establish this as a fact. But all experimenters have not agreed on this point, and besides it is a question whether in actual service and under all conditions the gain would be considerable, even were we not to take into account the lessening of tractive power from the inherent lightness of the electric locomotive. Since the introduction of electricity on our street railways, a great deal of information has been volunteered as to this peculiar effect of the current. It would be well, however, in our enthusiastic willingness to believe all that is good and nothing that is bad concerning the electric system, to remember one fact. We are prone to forget, or rather to overlook, the fact that in most of the practical tests which were made, and from which we are led to believe in the effect above referred to, the motor was beneath the car. Without any wish to controvert the advantages claimed to be due to an effect produced by the passage of the current between wheel and rail, we can but admit that the very circumstances which are quoted, relative to the effect, may in most cases, in all consistency, be brought up as substantial proof of the theory that the increased adhesion is due more to the additional load on the wheels than to the current. One glance at the steam locomotive slipping its wheels while getting under way on a track well sanded, can but bring us to a realization of the great importance of weight. The writer is fully aware that experiments which appear to substantiate the theory of the effect above referred to, have been made with an electric locomotive. But even admitting all this one can but question whether this increased adhesion can be made to compensate for the weight of—to make it the least—a huge boiler and furnace. It is, perhaps, unnecessary also to point out that on an extensive system the motors will necessarily be operated with currents at a high pressure but of small quantity, and for this reason our electrical tractive effect would be lessened. Besides this, who can say that, all things considered, the conditions may not be such that the rail-return will prove an unsatisfactory element in the system? Here then, is another difficulty which must be met. To be sure, an auxiliary dynamo worked in connection with the locomotive might be employed, but, if we may be allowed to theorize, can we not bring up the question as to what will be the effect in the long run of the continuous passage of a current of large volume between wheel and rail?

Steam railroad men are conservative, to put it mildly. These difficulties therefore must be met and overcome, and the results clearly demonstrated before we may hope for any substantial development in this field.

Chicago City Electric Light Plant.

The department of public works, Chicago, has secured a lot on Indiana avenue and Fourteenth street, which has been selected as a site for the new South Side power house for the city electric light plant. A brick building similar to those erected on the North and West sides will be constructed, and apparatus with a capacity of 800 arc lamps will be installed. The underground construction on the South side was completed early last fall, when it was intended to put a station on the lake front, but the plans of the city had to be altered, it will be remembered, and hitherto the department found it impossible to secure a desirable site. As soon as the station is erected connection will be made with the butt at Jackson street, and the South side will be illuminated by electricity.

It is proposed to organize a city lighting department under the joint supervision of the street department and electric department. In this way it is thought better results will be attained, as the gas and oil lamps will then be under the same authority as the electric lights. The appropriations this year are bunched, and it has not yet been decided how much of the money can be set aside for electric construction.

The Oregon (Ill.) Electric Light company was organized last week to furnish light, heat and power, capital stock, $5,000; incorporators, F. G. Jones, P. E. Hastings and J. C. Fesler.

Storage Batteries.

At the meeting of the Chicago Electric club, April 7, a paper on "Storage Batteries to the Rescue" was presented by J. K. Pumpelly. After the reading of the paper a discussion took place, of which the following is an abstract:

Mr. Bauer said electric train lighting in his opinion could not be successful without the use of the storage battery. He cited the case of the Pennsylvania road, stating that after the Limited left Chicago in the evening engines were changed eight times before the train reached New York. Unless storage batteries were used to bridge over the time while the engines were changed, the train would be in darkness. Again in another part of the line the train was run reversed, that is, the baggage car was attached to the rear of the train. In this case also, it would be impossible to continue the train lighting unless storage batteries were used. What was true on the Pennsylvania road was true of course of a number of other lines. That the Pullman company believed in the storage battery was apparent, Mr. Bauer said, from the fact that it had invested so many thousands of dollars in them. In reply to a question, why electric train lighting on the Atchison, Topeka & Santa Fe road had been abandoned, Mr. Bauer said it was a well known fact that the batteries had suffered from lack of attention. Inasmuch as the batteries were not properly cared for, it was not surprising that they were found to be unsatisfactory and were abandoned. The fact that the road had changed management had some bearing on its abandonment of electric lighting.

Mr. Degenhardt asked why the C., M. & St. P. had discontinued the use of storage batteries.

Mr. Bauer said he was unable to give an accurate answer to this question, but he expected to be able to explain the abandonment of the accumulators at the next meeting of the club.

Alex. Kempt said that he had had some experience with storage batteries, and he had yet to see a storage battery used whenever it was possible to use a dynamo.

Mr. Sperry said that he sympathized with the remarks of Sir Wm. Thomson that the electrical engineer should be nine-tenths mechanical engineer. As Mr. Kempt had said, he had never known of an application of storage batteries when it had been possible to obtain current direct from the dynamo. The case of the C., M. & St. P. road which had been referred to, was an illustration in point. Mr. Sperry spoke of the means adopted in Philadelphia of operating street cars by the steam storage system. This method, he said, was not a practical success, but he could not see why the steam storage system might not be employed to furnish steam when engines were changed, and thus the use of the storage battery could be discontinued. It seemed to him that with proper engineering it ought to be possible to discontinue the use of storage batteries in train lighting, and to obtain a current directly from the generator.

Mr. Bauer stated that he had found that the average life of the storage battery was about two years in train service. Sometimes it was as long as three years. He had noticed that it went to pieces all at once ordinarily. In the storage battery used for train lighting there was a certain definite charge and discharge. A set was charged with from five to twenty-five amperes. The current was taken out at the same rate of discharge. A battery used in that way ought to last indefinitely, but the great trouble was found with jolting. He had noticed in some trains lighted by electricity that the plates were all forced in one direction following the jolting motion of the car.

Prof. Badt said that it was pretty generally true that if an invention had a market value there was something in it. Capitalists had been putting large sums into accumulators and had spent a considerable sum of money in defending storage battery patents. He questioned whether these large sums of money would have been expended unless there actually was something of real value in the storage battery. He was confident that there was a value in the present storage battery, in spite of the fact that some present who had spoken thought it possible to get along without its use. He had seen batteries that had given perfect satisfaction. It was true, as Mr. Pumpelly had said, that there was a limit to the life of a storage battery, but he remembered with great distinctness that when he came to this country the dynamo was not characterized by longevity. When he had had his first experience with alternating current dynamos, their life, he was inclined to believe, did not much exceed four weeks, but there had been a steady improvement in the dynamo so that it was now a thoroughly durable piece of machinery. The incandescent lamp had a limited life, but no one considered the lamp valueless because of that fact. In the case of the storage battery it was not a question of life, but a question of cost. If the battery could be so constructed that the item of manual labor would be small, when it was no longer useful for work, a large percentage of the original cost could be obtained from the materials of which it was constructed. He had known of storage batteries which had been used with excellent success both in Chicago, America and Europe. He thought that the great trouble with them at the present time was to be found in the fact that it had been impossible to find men who could be trusted with the care of accumulators, but such efficient men would be obtained eventually. Storage batteries had frequently been put up improperly and had been improperly cared for, and naturally enough they did not give satisfaction. The same fact was true in the case of dynamos when they were first built. They were often put into places unfit for costly machinery. Then too, there were not at that time efficient dynamo tenders. Prof. Badt prophesied that the time would come when accumulators would be generally used for the operation of street cars. The time of the horse-car was passed and in the future the storage battery would furnish the power.

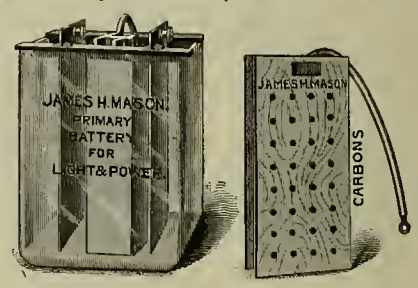
S. S. Leonard stated that he had ridden on both the Milwaukee and the Pennsylvania trains which were lighted by electricity, and both were beautifully illuminated. In the case of the Milwaukee road he had noticed that after most of the passengers were asleep the electric lights were put out and the oil lamps were lighted. If the company had continued the use of the storage battery he did not think this unpleasant change would have been necessary.

Mr. Bauer thought that the instructions of the engineers on the Milwaukee road was to run the electric lights all night. He thought that it might have been very likely in the case of which Mr. Leonard had spoken that an accident had happened which had made it impossible to continue lighting by electricity. Such an accident was of course liable to happen at any time. He wished to state, however, that the Milwaukee road had not entirely abandoned the use of storage batteries. In a train which ran to Omaha the batteries were carried as before.

President Beach said that from a telephonic standpoint he was extremely glad to hear that the storage battery was becoming so successful. The single trolley system which the electric railways were using was extremely disastrous to all the telephone companies. They were suffering and hoping that something would be done to mitigate their troubles. Therefore, he and all persons interested in telephony were greatly concerned in all investigations which might lead to the perfection of the storage battery for street car work.

Primary Battery.

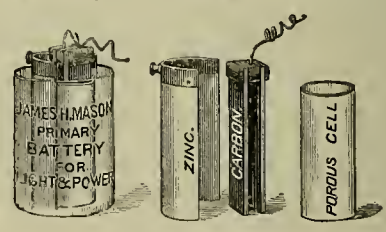
Each branch of electrical science appears to have a certain number of workers who believe that the future has great things in store. Now that competition among manufacturers of dynamos and motors, has become so strong, a number of inventors are devoting themselves to branches as yet undeveloped, and as a conse-



PRIMARY BATTERY.

quence the much maligned primary battery comes in for its share of attention. For the benefit of those who may feel an interest in the progress in this field, there are presented herewith a description and illustrations of another primary battery. This cell is the invention of J. H. Mason of Brooklyn, N. Y.

The inventor makes a number of strong claims for the battery. It is stated that the e. m. f. is



PRIMARY BATTERY.

high and constant, with a very low internal resistance. No crystals form on the carbons and there is little or no local action when the cell is kept on an open circuit for a length of time. The new zincs for the cell are prepared in such a way that they keep clean and bright. It is further claimed that the action in the battery is such that the solution instead of the zinc is used up—in other words, that it is necessary to replenish the fluid more often than the zinc. As the cost of the fluid is less than the zinc, Mr. Mason considers this a feature of importance. Perforated carbons are used.

International Exhibition at Jamaica.

The attention of electrical manufacturers is called to the fact that an international exhibition will open at Jamaica in January, under the auspices of the government. The buildings are already completed and the main hall is an imposing structure 511 feet in length. No charges will be made for space in the exhibition building, nor will duties be levied upon any exhibits unless sold in the island. The geographical position of the island and the salubrity of the climate will undoubtedly attract a large number of visitors from the neighboring islands and South and Central America, as well as from the United States. There is constant and regular communication by steam between New York and Jamaica, and the island is also connected with the United States by cable.

In addition to the present accommodations for visitors, a large hotel has been recently erected and opened, near the exhibition grounds, under American management. The railroad system of the island, which has been recently taken over by an American company, is rapidly being extended. In view of the increasing trade between this

country and Jamaica the committee have appropriated considerable space for American exhibits.

The regulations of the committee, and full information as to the mode of shipment, rates of fare and marking of exhibits, and all other particulars as to the scope and object of the exhibition, will be cheerfully furnished by the secretary, Thomas Amor, 280 Broadway, New York. Many American manufacturers of electrical apparatus will undoubtedly be glad to take advantage of this opportunity of displaying their products in a new field.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 12.—The very abrupt manner in which the Board of Electrical Control settled the subway contract was somewhat unlooked for, and was no doubt a big surprise to the public. At its last meeting, in the absence of Wheeler H. Peckham, counsel for the Standard Subway company, the mayor said: "I think it amounts to this, that the Standard company will not carry out its arrangement with the board. The city has been acting in good faith throughout this whole matter in hopes of getting a good contract executed. Now the board finds that its action is retarded because the Standard company has no counsel here. This does not seem to me to be a proper way of doing business." The contract as amended by the court was therefore not carried into effect and a unanimous vote of the board rescinded the resolution to enter into a contract with the Standard company. This leaves the Consolidated Telegraph & Subway company free to go ahead and build subways, as indicated by Commissioner Gilroy. Permission was granted the Edison company to construct subways for its system as soon as the s reets were selected. Commissioner Gilroy does not mean to have any of the streets torn up for subways after they have been repaved, and all companies interested in subway construction will indicate which streets must be used for conduits to serve their ends and those of the public.

It is said that the first electrical execution will, by an arrangement of the superintendent of prison department, the warden of the state prison at Auburn, and Dr. Carlos F. MacDonald, be witnessed by representatives of the Associated Press and the United Press. The officials may shield themselves behind the provision of the law which permits the publication of the fact. The law says, however: "No account of the details of any such execution beyond the statement of the fact that such convict was on the day in question duly executed according to law at the prison, shall be published in any newspaper." Yet, unless these reporters see fit to give in detail an account, and newspapers are inclined to publish such detailed account, the statute will remain unbroken. The matter rests with each individual newspaper whether it will remain silent or publish the entire proceedings on the ground that the act of the legislature is unconstitutional from the fact of its containing the clause regarding publication of the execution. It rests with the newspapers and the legislature to settle the matter as to the constitutionality of the law. The newspapers of this city have an opportunity of disarranging the plans of the authorities, but it is hardly possible now for them to do it. The whole question of the constitutionality of the act might be reopened to test the validity of the clause providing for a suppression of the details of the execution.

The electrical exhibition at Lenox Lyceum is attracting the greatest interest. Edison's private exhibit is truly a marvel, and the Woman's Exchange is more than fortunate in securing this interesting collection of inventions. Thousands have already attended, and during the next six weeks the opportunity of listening to fine music amid the wonders of electricity, will afford a most delightful way of spending a leisure hour.

The Jamaica & East New York Electric Railway suffered slight damage in its overhead trolley wire, and for a short time last Tuesday there was danger to passing vehicles, one of which encountered the dangling wire and the horse was killed by the electric shock. The wire was immediately repaired.

The members of the Wholesale Grocers' Exchange of Philadelphia held a special meeting last Wednesday, to take action against the Bell Telephone company, and a committee of five members was appointed to confer with other exchanges to devise plans for renewing an organized warfare against the company.

Judge Wallace of the United States Circuit Court has handed down a decision in the case of Thomas A. Edison vs. Gilliland and Tomlinson, in which the demurrer made by the defendant is sustained.

The Gas Commission received bids from the gas and electric companies this week for city lighting. The latter advanced its prices 20 per cent., and stated this was due to the fact that the companies had to pay rental for subways. No action was taken by the commission.

The New York Electric club will hold its annual election Thursday evening, from 5:30 to 8 o'clock. The following ticket, nominated at the club meeting March 18th, will undoubtedly be elected without opposition: President, O. E. Madden; vice-presidents, Grosvenor P. Lowrey, Erastus Wiman, Gen. E. S. Greeley, W. D. Sargent; secretary, Chas. W. Price; treasurer, Willard L. Candee; board of managers, J. C. Chamberlain, H. L. Storke, J. J. Carty, Cyrus O. Baker, Jr., J. H. Herrick, C. H. Barney, H. D. Stanley, Geo. B. Coggeshall, S. Insull, John A. Seely, C. E. Stump, A. H. Patterson, W. J. Morrison; committee on membership, Henry Hine, chairman; Lieut. F. W. Toppan, F. Z. Maguire, Geo. T. Manson, Geo. Worthington.

The shops of Lewis & Fowler, manufacturers of street railway cars, were badly damaged by fire the early part of the week, and it is estimated that the loss will reach $100,000. W. H. T.

St. Louis, Mo.

ST. LOUIS, Mo., April 12—The immense amount of money which the street railroad companies of this city are investing in electric systems is attracting attention all over the country, and is the chief topic of conversation here. St. Louis has indeed awakened to the possibilities in electric railways. The Lindell Railway company is pushing matters vigorously toward the completion of its electric system, and the road will be in operation about the first or middle of August. Ties have already been distributed along Lucas avenue, from Compton to Grand avenue, and last week they were delivered along Page avenue, and the work of putting them down will begin soon. The cars for the line have been under construction for sixty days, and all the rolling stock is expected to be delivered by the 1st of May. Sixteen electric motors of the Sprague system arrived last Saturday. The poles and overhead wires will be put up in July. The power house, which is to be located on the west side of Compton avenue, two squares north of Chouteau avenue, will contain four engines, each one of which will be 400-horse power. The power plant will cost all the way from $125,000 to $150,000. The whole road will cost about $1,200,000 for equipment. There will be $100,000 worth of wire alone used in the construction. The entire capital for the enterprise is furnished by citizens of St. Louis. The motors will be used on the entire system, both on the main line from Third street and Washington avenue to Forest Park and on the Chouteau avenue extension, which branches off from Fourteenth street and Washington avenue south to Papin street and up Papin and on to its route west on Chouteau avenue to Forest Park. The street from the old Manchester road to King's highway, by the Bates statue, has never been opened, and the Lindell Railway people are trying to get the consent of the property owners in that vicinity to open the street before it is dedicated, in order to facilitate matters. The real estate along the main line of the road in the West End has taken on a veritable boom since the franchise was granted the road, and it has become a settled fact that it will be constructed. The value of real estate on this line has doubled within a week.

Several car lines which were somewhat tardy in meeting the demands for improved service were threatened with boycott unless they provided conductors, took off their bob-tails and introduced electricity as a motive power. Most of the companies complied, but others, failing to do so, are now suffering from a spirited boycott. An officer of one of the companies says: "The drivers have been instructed that when any person refuses to put his fare in the box, to stop the car, go inside, courteously request it, make the change desired, and then put the fare in the box. If any person, under these circumstances, refuses to pay, then he will be ejected from the car - by the passengers, I suppose, for no one will be hauled free. The Benton-Bellefontaine intends to be running by electricity before September 1, and the ordinance giving us the right to change our motive power obligated us to remove the bob-tails within 18 months, anyhow."

An amusing incident in this connection came to light at a meeting of indignant citizens. One of the leaders of the boycott, a barber, whose shops are near the headquarters of the company, complained bitterly that the employes of the company, who were his main support, had boycotted his shops since the movement had been incorporated. He had refused to put his fare in the box when an officer of the company was on the car, and since that time the men have not patronized his establishment. He believed in boycotting the street car company, but could not appreciate the justice of the retaliatory measures inflicted by the employes of that concern.

The stockholders of the St. Louis Railway company (Broadway line) re-elected Supt. Robert McCulloch and Gerhard Droege directors of the road. This company is soon to commence work on its proposed Broadway line, for which a franchise has been recently granted. It has been generally supposed that this line was to be cabled, but a report is current to the effect that the company had altered its original intention of putting in cable, and that it had decided to use electricity as a motor power.

A large crowd witnessed a test of the new electric system on the Blue Line. The trial was made on the extension, from the power house to the Monks' church on California avenue. The power house is in an advanced state of progress, and prior to the trip visitors were taken over it and the system explained. The party then boarded one of the 30 cars specially constructed for the Union Depot line. It is elegantly fitted, and is lighted by electricity. The passengers included J. Scullin, H. Scullin, Thomas Barron, the assistant superintendent; Mr. Seaman, vice-president of the company, and several invited guests. In order to make the trial as thorough as possible, a free ride was offered the spectators, and when the car started it was uncomfortably crowded. The test was satisfactory in every respect. The total distance covered was five miles, and the time occupied about 36 minutes, including several stops. The car rounded the curves very smoothly. It is proposed to run the extension by electricity and the company expects to be running right through to Fourth street within a month. O.

Topeka, Kan.

TOPEKA, April 12.—J. L. Beardsley has begun suit in the district court against the Topeka Rapid Transit company to recover judgment for $5,000 for personal injuries alleged to have been received by him January 6, 1890, when he was employed as a motorneer on the company's road. The petitioner states that while running a motor his wrist was caught between the fenders of two cars while he was endeavoring to prevent a collision.

The work of constructing the electric system over the lines of the old city railway company has begun and will be pushed as rapidly as possible. To facilitate matters, the North Topeka line will not run beyond Thirteenth street until further notice, and passengers for the north part of the city will be transferred at that point to the electric cars. H.

Kansas City, Mo.

KANSAS CITY, April 12.—A communication from Norton Thayer and T. J. Enright accepting the franchise recently granted for their proposed electric street railway on Seventh street, was received at the last meeting of the council of Kansas City, Kan. The communication was accompanied by a certified check for $5,000 and a bond for $5,000. Mr. Enright asked that the company be required to put up a bond of $10,000 instead of a bond for half that amount, and $5,000 in cash, but he was informed that this could not be done without amending the ordinance. The Thayer-Enright company will ask that the council amend the franchise by giving them the right to run up Seventh street from Kansas avenue to the boulevard, instead of jumping across to Eighth street at State avenue, thence running north along Eighth to Walker and back again to Seventh. The company will also ask that the franchise ordinance be amended in the matter of the bond. The road will probably be built this year.

The presentation of the petition signed by a number of business men, asking the city to dismiss the action pending in the district court against the Kansas City Electric Light company, was another important feature of the Kansas City, Kan., council meeting. The petition recited that as a result of the Kansas City company being prevented from operating its system, competition in electric lights was cut off. Action on the petition was indefinitely postponed.

The Western Union Telegraph company, it is learned, is making experiments on a fast circuit to California. It is working on establishing a direct wire to San Francisco from Kansas City, Mo.

President Mulvane of the Missouri & Kansas Telephone company, while in Kansas City, Kan., last week, conferring with the mayor and chief of the fire department, agreed to make a very liberal concession in telephone rates. In fact, Mr. Mulvane agreed to make the rate to the city just one-half what the city has been paying for telephones. At the present time the city has in use six telephones, and the annual cost is about $6. It is proposed not only to place these at fifty cents on the dollar, but also to make the same rate for any additional telephones that may be ordered. The company also agree to operate a fire alarm circuit and keep it in repair free, providing the license on its poles is remitted. The city will pay for the wire for the fire alarm circuit, which will cost about $50.

The Kansas City & Independence Railway company was organized in 1884, but the construction of the road has not been taken up, although the Independence avenue branch of the Kansas City cable railway system may perhaps be

considered a part of the line. The company has given notice of a meeting to be held June 2, at which time it will be considered whether it is advisable to increase the capital stock from $100,000 to $400,000, and issue bonds for the floating indebtedness to the amount of $400,000. The road will be a second line to Independence, and an electric motor line at that.

The Kansas City Electrical society held its regular meeting last Saturday evening, and the proceedings were of a particularly entertaining character. The important paper of the evening was on the subject of "Electric Light Wiring and Insulation," and the discussion on the subject was quite entertaining. P.

St. Joseph, Mo.

St. Joseph, Mo., April 12.—The council took up the electric light matter two weeks ago, and after two hours' work in a committee of the whole the plant was accepted and an ordinance was passed appropriating money to make the first payment and pay the expenses of running the plant for the past three months.

The cost of the plant, as agreed on, is $48,668.60, a $2,084.40 credit having been given for a deficiency in poles. The expense of running the plant for a month and a half, beginning Jan. 13 and ending March 1, was $1,486.11, making the cost per lamp per month $4 75. The committee of the council reported that from the foregoing figures it did not believe the cost in the future would be nearly as great as in the past.

At the annual meeting of the shareholders of the People's Street Railway & Electric Light & Power company, the following named officers were elected for the ensuing year: Lathrop R. Bacon, president; W. T. Van Brundt, vice-president and general manager; Arthur J. Moulton, secretary and treasurer, and the following named gentlemen were elected directors: Col. Winslow Judson, Chas. B. France, Chas. A. Shoup, Thos. Van Natta, J. A. Corbey and Wm. T. Van Brundt all of St. Joseph, Mo.; and Wm. M. Harriman, Isaac B. Newcombe, Stephen S. Palmer, Camilla Weidenfield, Thos. H. Thomas, L. R. Bacon and Arthur J. Moulton of New York.

The Union Railway company is still enjoined from operating its cars south of Duncan street by electricity, and it is a question as to who will finally win, the railway or telephone company.

Judge Henry S. Kelley, attorney for the railway company, said recently: "A temporary injunction was issued by Judge Ramey by which the Union company is prevented from operating its cars by electricity south of Duncan street. This injunction was allowed on the *ex parte* statements of the petitioner without hearing the street car company's side of the case and it holds good until the case is fully heard on its merits or until otherwise ordered by the court. The answer has not been filed yet but we expect to file it during the present term, so that the case may be tried next month. The suit here is one of a number brought against the electric railway companies in different parts of the country, all of which involve substantially the same, or some of the same questions. Some of the other cases were so much in advance of our suit that we expected decisions in them that would be useful to us in the trial of our case, so we have not pressed a hearing at this term. The case in Cincinnati differed from our case in some important particulars, and cannot be regarded as an authority here of much weight, but the telephone company claim it as a victory. If it be a victory for them it is the first one I have heard of, while the street car companies have defeated them in every other case so far as I know or have heard."

For several months past the People's Street Railway company has been trying to perfect some arrangement whereby it could reach the Union depot with its lines. Some time ago the People's company proposed to extend its line from Messanie to Olive street and run over the Union tracks to the Union depot, and made a proposition to pay that company a reasonable rental, but the Union people positively refused to entertain it.

This refusal, however, does not seem to have drowned all hopes of the People's company, and several days ago it started out with a petition to the common council for the right of way to lay double tracks and erect poles and wires from Messanie street to the Union depot.

The People's company will agree to lay tracks parallel with those of the Union line and six inches to either side. Such an arrangement would only lessen the roadway a foot, and it is claimed the People's cars could be operated in such manner as not to interfere in the least with the operation of the Union company's cars.

Messrs. Amick & Brown, attorneys for the People's company, state that the petition is all ready to be presented to the council, and that they have no doubt that the franchise will be granted. If the franchise is granted the People's company will issue transfer checks to passengers, so that a person can take a car at the Union depot and ride to any portion of the city reached by its system. The Union company says there is no possibility of the People's company accomplishing what it is contending for.

A party of representative business men of Oregon, Holt county, composed of Judge George Anderson, Lewis I. Moore, Thos. Curry and Hiram Herstberger, were in the city last week on a mission which will prove of the utmost importance to the citizens of Oregon and Forest City. They paid a visit to Secretary Steinacker of the Union Electric line, and laid before him a proposition for the building of a line of electric railway to connect Forest City and Oregon. The route has been surveyed and found very practicable, a 6 per cent. grade being the highest to be overcome. The route will be a trifle over three miles in length. Mr. Steinacker made an estimate which fully satisfied the gentlemen that the plan was feasible. The estimated cost of building and equipping the line will be $20,000. This will include a number of arc lights to be used in Oregon and Forest City. D.

Boston, Mass.

Boston, Mass., April 12.—At the Statehouse on Beacon Hill this week has been an important one electrically. Nearly all of the orders introduced during the winter which were in any way connected with electrical matters were referred at once to the committee on mercantile affairs, and now this committee is devoting most of its time to hearings upon a variety of "electrical" orders. Hearings have been announced and are now in progress upon orders as follows: Supervision and control of overhead and underground wires; requiring metallic return circuits and prohibiting the use of high tension currents; making owners of wires responsible for injuries not caused solely by the negligence of the party injured; requiring wires to be tagged at short distances with names of owners and records to be kept of same; dangerous electric light wires kept alive during the day; granting cities and towns full control over poles and overhead wires; a commission to supervise electric light wires; as to a state board of electric control, and as to appointment of officers in cities and towns to supervise overhead wires. At these hearings, from day to day, all the prominent electrical companies owning overhead wires in Boston have taken part in the discussions. Arthur Lord appeared as counsel for the Western Union company, Ferdinand A. Wyman for the Westinghouse company, Geo. A. Bruce and Fred. H. Williams for the Bell Telephone company, Samuel L. Powers for the New England Telegraph and Telephone company, W. W. Gooch for the Edison company, and the Massachusetts Electric Lighting association was represented by E. W. Burdett. Some legislation upon this subject will doubtless be recommended by the committee, though it is impossible to predict what it will be. A petition was considered a few days ago by the same committee which was presented by Prof. F. M. Gilley and others of Chelsea, asking for the appointment of a state inspector of electric lights and meters. It is expected that a bill will be presented and recommended for passage, which provides for such an appointment.

The State House of Representatives has concluded that there may not be any need of legislation to give cities the right to operate their own lighting systems, and has asked the state attorney-general to give his opinion, "with reasons therefor," "as to whether, under the existing statutes, cities and towns have the authority (1) to construct and maintain within their own limits and for their own use systems of lighting by gas or electricity; and (2) whether in connection with such systems they may sell gas or electricity for private use in such towns and cities."

The present slow speed of the electric cars is ridiculed by nearly every daily paper in the city, and in very emphatic terms by the traveling public. Seven miles an hour is the limit set by the aldermen for the business streets, and now it has been discovered by the aldermen and the public that this is even a much less rate of speed than that ordinarily made by the horse cars. On all of the lines, where for a part of the way electric and horse cars are both running, the electrics invariably detain the horse cars. As was expected, remonstrating petitions have been presented to the aldermen. A public hearing upon the matter is to be given. The passage of the slow speed order is credited to the advocates of extensive systems of elevated roads for the business section of the city. A repeal of the order is expected.

The committee on electric wires of the board of aldermen reported in favor of granting the recently submitted petition of the Suburban Light & Power company for leave to erect 861 poles in Roxbury and Dorchester, the aldermen, according to the petition, to specify the locations.

The board, however, refused to suspend the rules and pass the order at once by a vote of 7 to 5, and the matter will come up again at the next meeting. This company, it will be remembered, is making an effort to obtain a foothold and install a plant of the new Westinghouse alternating arc system, but is opposed by the now established Boston Electric Light company. Its last petition to the board of aldermen was for permission to erect 861 poles in specified locations, and the petition being refused, an effort was made to secure a mandamus compelling the board of aldermen to grant the desired right. It was held, however, that the aldermen had not refused absolutely to grant the company locations, but only in those places specified in the petition. The petition now before the aldermen was drawn to avoid this difficulty, and if it is refused by the board, as it probably will be, the matter will be again taken to the courts in the effort to compel a compliance with the terms of the petition.

The Cambridge aldermen on Tuesday night of this week repealed the order forbidding the West End Street Railway company to run trains of two cars through the streets, the only important provision being that two men be placed in charge of each car, and that fenders be placed upon the cars as soon as possible. On Wednesday morning trains were running again.

C. L. Edgar, general manager of the Boston Edison company, has just returned from Europe, where he has spent nearly two months in company with John I. Beggs of New York, inspecting the operation of European central stations.

F. E. Pettingell, of the firm of Pettingell, Andrews & Co. of Boston, has also been home from England but a few days His trip was entirely a business one, and he has been away but a few weeks.

Joseph Wetzler will read a paper on next Monday evening before the Boston Electric club on "Electric Railway Evolution." The lecture will be illustrated by lantern slides.

Prof. F. M. Gilley of the Chelsea high school, is expected to read a paper before the Society of Arts next week on the central electric lighting stations of London.

H. G. Balkam, superintendent of the Edison Electric Illuminating company of Brocton, Mass., was in the city this week. He says his company is just installing a 175 horse power Edison 500 volt power generator to furnish power for 500 volt motors, run from an exclusive power circuit. These motors are largely used in shoe factories. Two 25 horse power motors are already in use. The electric railway in Brocton is furnished with power from Mr. Balkam's station. This is now operated with 7½ horse power, old style Sprague motors, but is soon to be fitted out with 15 horse power latest type of motors, and will be extended to Whitman, a neighboring town. Mr. Balkam is convinced that the attractions of the electric railway have very largely increased the value of real estate along the line and in its vicinity.

The Thomson Electric Welding company is arranging to supply welding plants at the navy yards in Brooklyn, Norfolk and Washington, and it is reported in a dispatch from Washington that an item of $12,000 has been reported to the house by the naval committee in the appropriation bill for a chain welding plant for the Charleston navy yard.

Commodore N. H. Farquhar, chief of bureau of yards and docks, navy department, is to come to Boston soon to inspect the electric welding process here and at the Lynn factory.

It is said that W. A. Boland, who is now in London in the interests of the Thomson European Welding company, is soon to have an opportunity of exhibiting the welding machines of Prof. Thomson to a large gathering of English electrical engineers.

On Easter Monday, Dr. Phillips Brooks, rector of Trinity church, entertained a large number of guests at his home. One of the attractions placed in one of his rooms was an Edison phonograph, which did much both to amuse and astonish many of his parishioners.

The New England Telephone company is soon to put in a new metallic circuit line between Boston and Watertown, Newton and Waltham. The company is doing a large amount of construction work, and has this week sold $500,000 6 per cent. bonds to Blake & Company, bankers. There were already $500,000 of the company's bonds outstanding. The bankers who took the new bonds disposed of the entire lot in less than a day. The last sale of the bonds was at 104.

The annual meeting of the Thomson-Houston Electric company's stockholders will be held next Monday. At their special meeting on the 5th inst. it was voted to increase the common capital stock 120,000 shares, or $3,000,000, reckoned at par. The official statement of the authorized capital stock of the Thomson-Houston company is as follows: Common stock authorized, $7,500,000; common stock issued, $4,500,000; preferred stock authorized, $4,000,000; preferred stock issued, $1,000,000; total stock

authorized, $11,500,000; total stock issued, $5,005,000. Of the $3,000,000 preferred stock authorized, but not issued, about half has been sold to be held in trust for a year, the company holding an option on it and having the right to buy it back. This stock is, however, practically issued, making $7 000,000 of issued stock out of a total of $11,500,000 authorized stock.

Prof. Elihu Thomson delivered a lecture on Thursday evening of this week before the Massachusetts Society of Arts upon "Alternating Current Induction." The lecture was accompanied by experimental demonstrations similar to those presented by the professor before the American Institute in New York last week. O. H. M.

Leavenworth, Kan.

LEAVENWORTH, April 12.—The dummy line has been sold. J. A. Bovard of Kansas City, president of the old Riverside coal mine, is president of the new concern, and D. S. F. Neely is vice-president. Parties who have suits pending against this line have consented to withdraw them, so that the new managers may start up without being handicapped in any way. The business men of this city desire to see this road prosper.

The dummy line proper, or the part of the Wyandotte system, that has been purchased by this new company, will extend from Fort Leavenworth to Mount Muncie cemetery. From the glucose factory to the cemetery will be built a new and separate track, so there will be no changing of cars or delays, but on the contrary the line will be a direct one between these two points. These gentlemen are now negotiating with the electric light company of this city with the view of using electricity as the motive power, which will greatly enhance the usefulness of the road. If satisfactory arrangements cannot be made with the electric light company for motive power, the new concern will put in a plant of its own.

The ordinances for this new line are now being prepared, and in all probability will be presented before the council at its next regular meeting. No efforts will be wanting to push the matter to completion. F.

THE ELECTRIC LIGHT.

The Dallas, Ore., electric light plant will be enlarged.

An electric light plant will be erected at Greenville, Ala.

The Southern Construction company is negotiating for an electric light plant at Henderson, Miss.

The Morristown Electric Light company of Newark, N. J., will put a new 130-horse power engine in its plant.

The Winifrede (W. Va.) Coal company is considering the question of adopting an electric system for light and power.

The Belton (Tex.) Electric Light company has been incorporated to furnish light and power with a capital stock of $200,000.

Salt Lake City is to have a lighting plant of the Westinghouse alternating current incandescent system. The initial capacity of the plant will be 500 lights.

The capacity of the Manitou Electric company, Manitou Springs, Colo., has been increased by the addition of Thomson-Houston 30 light arc and 300 light incandescent machines.

The Grafton (W. Va.) Light, Heat & Power company has purchased a site and will begin the erection of a power house at once. It will be equipped with Thomson-Houston apparatus.

The Collinsville Electric Light, Heat & Power company has been formed at Collinsville, Ill., with a capital stock of $25,000; incorporators, Louis Lumaghi, George Hadfield, T. J. Thomas.

Several companies are endeavoring to secure a franchise for an electric light plant in Atlantic, Ia. The city council will decide the matter next week. There is some talk of the city putting in the plant.

The Edison Electric Illuminating company, of Cumberland, Md., has just placed an order with the Westinghouse Electric company, of Pittsburg, for one 45 light dynamo of the new alternating current arc type.

A. W. Wright, Alma, Mich., has purchased a plant of 20 arc and 650 alternating current incandescent light capacity, of the Thomson-Houston system, to be used in the sanitarium, hotel, and other public buildings.

The new arc lighting system of the Westinghouse Electric company is to be installed at Troy, N. Y., in the near future. The Westinghouse Electric company has received an order from that place for a 60 light machine.

The National Electric Light & Power company of Kansas City, Kan., has been incorporated with a capital stock of $50,000. The directors are W. A. Thomas and J. F. Saunders of Guthrie, Oklahoma, and M. F. Bailey, Chas. Hutchings and E. L. McDowell of Arkansas City.

The Monongahela Mining company is about to light one of its mines by electricity. The plant is to be of a special character so as to make it perfectly safe and economical. A current pressure of 300 volts will be utilized on the line, and the lamps will be placed in series of three throughout the mine. The arrangement in the shaft is such that three lamps can be extinguished at one time. The capacity of the plant is 150 lights and the Westinghouse Electric company has the contract for furnishing the apparatus.

The Westinghouse Electric company has been awarded the contract for installing a new central station plant for electric lighting at Portsmouth, Va., with alternating current apparatus. The plant will start with a capacity of 1,500 lights.

Fort Collins, Colo., will soon enjoy the advantages which electricity as an illuminating agent affords. The Westinghouse Electric company has just received an order from Fort Collins for a 750 light dynamo, and the machine will be shipped without delay.

The Edison Illuminating company of Rochester, N. Y., has begun the construction of a new power house on the river flats. It will put in 300-horse power water wheels and the same capacity of engines. The Brush company has installed a 600-horse power Cooper Corliss engine and steam plant as a reserve.

A Fisher 40-light incandescent dynamo has been installed in a steam yacht at Detroit for illuminating the cabin and berths. The dynamo is belted direct to the engine, and the outfit is compact and weighs about 200 pounds. The Fisher Electric company of Detroit made the installation and has several contracts for similar plants on hand.

The St. Louis Municipal Electric Lighting company has its plant in order in the district south of Washington and west of Jefferson avenues, and is completing its circuits through other parts of the city. It is thought that the company will be ready to undertake the fulfillment of its contract by the middle of the month. The lights are in operation in the completed district.

Hoquiam, situated in the new state of Washington, is not a very widely known town, but it is an enterprising one, and may be heard from more extensively in the future. A company to carry on an electric lighting enterprise was recently organized in Hoquiam and has placed with the Westinghouse Electric company an order for an alternating current incandescent dynamo of 750 lights' capacity, and a 50 light arc machine of the new alternating current type.

The Municipal Electric Light company of St Louis, denies the statement that it has strung several hundred miles of wire without permission of the Board of Public Improvement. The company says that it has strung considerable wire, but only along the thoroughfares it is to light with electricity under its contract with the city. The company claims that it cannot understand why the board was so misinformed. The Municipal Electric Lighting company has not yet informed the board when it will be ready to have the relative advantages of the lamps tested.

The village of Saratoga Springs, N. Y., will be illuminated with electric lights during the coming season. The resort is to be furnished with a central station plant of 3,000 lights' capacity. But besides that there will also be an arc light plant of 120 lights. Owing to the fact that the lights will have to be distributed over an extensive area the machinery is to be of a special kind. A 2,000 volt pressure is to be used on the line The plant will be furnished with the Westinghouse alternating current system. The new Westinghouse arc light system will be introduced.

A recent issue of the Birmingham (Eng.) *Daily Gazette* contains an account of the introduction of electric light in that city. About seven years ago an attempt was made to establish an electric light station in that city, but owing to lack of financial support it proved an unsuccessful venture, and not until the present time has any systematic attempt been made to take advantage of this superior form of illumination. Even now it is not considered advisable to extend the service to street illumination. A correspondent writes on this point: "That the absence hitherto of any extended scheme of electric illumination in that town should be regarded as a thing not altogether to be regretted in view of the valuable experience acquired at the expense of more progressive people, is intensely characteristic of English procedure. In the case of any departure from established business methods their maxim seems to be 'Try it on the dog.'"

Another interesting proposition, though one that has not yet taken definite shape, is the formation of a company for the insurance of dynamo electric machinery from loss by fire from any source, and especially from accidental short-circuiting. It is believed that the standard insurance companies will gladly welcome the establishment of a company for this purpose, and will help it to success, while the local companies should be not less willing to patronize a corporation composed of trustworthy and responsible men, and offering a fair scheme of underwriting. There was a time when the burning-out of armatures was a most ordinary occurrence. Even to-day there is far too much of it; but the improvement in construction has been so great during the last year or two, and the manufacturing companies are manifesting such marked improvement in this direction, that it seems reasonable to believe that the burn-outs may now be figured down very closely, and to an average small percentage.—*London Electrician.*

THE ELECTRIC MOTOR.

The Thomson-Houston company's road at San Jose is completed.

The Stockton avenue line in San Jose will be equipped with electric motors as soon as the line now in course of construction is completed.

The Seattle (Wash.) West Street & North End Electric Railway company has awarded contracts for grading and bridging the whole line, which is to be completed by June 15. It is the intention to have the line in operation about July 15. A company is organizing to construct an electric road through South Seattle.

It is reported that a large grist mill will be built at Arlington, Ore., and operated by electric power generated at the falls of the John Day river.

Joplin, Mo. has granted a franchise to O. B. Steen and associates, organized as the Joplin Real Estate Investment company to build an electric railroad of the overhead system.

The Thomson-Houston Electric company of Boston, Mass., has been awarded the contract for equipping the new power house at Big Stone Gap, Va. This will be one of the largest plants in the state, it is claimed.

W. B. Knight's Northeastern road, at Kansas City, Mo., equipped with the Thomson-Houston system, was started March 11, with six cars. This is the only electric line in Kansas City, Mo., which runs into the business center of the city.

Electric street railroads have proved not only popular but paying in Tacoma, Wash., and the surrounding districts. There are now eleven miles of street railroads in the city operated by electricity, and four more miles will be added. The suburban lines are also extensive. It is proposed to convert the Lake park line into an electric system at an early day, and it is quite probable other lines now operated by steam will be changed to an electric service as soon as the patronage will warrant the expenditure.

Dr. F. G. Hentig, general manager of the new Los Angeles, Cal., Electric Railroad company, has arrived in that city to begin active operations in putting the road in shape. The officers of the company are Dan McFarland, president; Byron Roberts of Topeka, vice-president; W. W. Mouspeaker of Topeka, secretary and treasurer. The company has purchased the franchise of the old company, and proposes to utilize all the old plant possible. The contracts for the rolling stock have already been let to the Pullman company. The company will use the Sprague system. Dr Hentig hopes to put the first section in operation by July.

An extensive system of electric roads is in process of construction in and about Colorado Springs, Colo. A company of capitalists was organized in that city about one year ago with the intention of building one of the finest systems of rapid transit railroads in operation in the country. The company organized was called the El Paso Rapid Transit company, and F. L. Martin, A. A. Lawton, A. A McGovney and E. J. Eaton of Colorado Springs, M. A. Leddy of Manitou, and E. W. Brady, A. L. Hughes, A. B. Brady, W. M. Smith, C. A. Nebeker and O. W. Brady of Davenport, Ia., became the principal stockholders in the new company. They went earnestly to work and the result is that the city is being covered with a network of tracks, and by May 15 electric cars will be spinning through the streets. The city council gave the company a franchise through the principal streets and the county commissioners gave them rights on certain country roads. On March 1 the name of the company was changed to that of the Colorado Springs Rapid Transit Railway company. A few months ago the company purchased the stock, franchises and equipment of the Colorado Springs-Manitou Street Railway road. The contract for the electrical equipment of the system was awarded the Sprague company. The power house will contain two 175 horse power Corliss engines and four 80 horse power Edison dynamos. Already sixty miles of wire have been strung. Eighteen motor cars and as many trailers are now in course of construction at the Pullman shops, Chicago, and will soon be ready for shipment. In connection with the approaching opening of the system the *Gazette* of Colorado Springs, says: "It is difficult to realize the great advantage of rapid transit or the value to our city. In a few weeks it will be possible to visit Cheyenne Canyon and Austin's Bluff in a very short time for the price of five cents, whereas it now requires several hours to come and go and costs at least $2. To the poorer classes who may desire to take an afternoon outing in the mountains, the road will prove a boon. Colorado City, and eventually Manitou, will be a few minutes' ride of the city, while the additions to the east, west, north and south parts will not be so very inaccessible that they will be felt to be far removed from the city. The cars will travel at about the rate of twenty miles an hour."

THE TELEGRAPH.

It is proposed to hold an international telegraphic conference in Paris this year, and invitations have been sent to all the telegraph companies in the world. The date of the conference is not yet fixed.

A telegraph office was established at Bhutong during the Sikkim, British India, expedition. It enjoys the distinction of being the highest in the world, its altitude being 13,500 feet above the sea level.

For a number of years exhaustive information on electricity in storms, with special regard to the influence of atmospheric electricity on the telegraph service and on telegraph apparatus, has been collected by the Imperial Telegraph department, Berlin. At present 900 telegraph offices have instructions to keep a record of the cost, duration and direction of storms. From the observations made it appears that, while not altogether free from the influence of atmospheric electricity, such influence is materially smaller in the case of underground wires as compared with wires above ground. In regard to town telephone wires it is worthy of remark that, notwithstanding the violence of several of the storms in the towns having a telephone system, the accidents from lightning compared with former years were strikingly few, and the assumption does not, therefore, appear to be without justification that the wires stretched over the roofs afford effective protection in equalizing atmospheric electricity.

Miscellaneous Notes.

A meeting of the executive committee of the National Electric Light association was held at New York Monday, the 14th.

The Automatic Electric Exchange company has been incorporated at East St. Louis, Ill., to manufacture electric apparatus. Capital stock, $100,000; incorporators, W. H. Ford, A. Leslie and H. Overstolz.

The Michigan Board of Underwriters has adopted all the rules of the New England Electric Exchange for wiring of buildings, together with some new rules accepted by them, but not yet promulgated.

The annual meeting and election of the Chicago Electric club was held Thursday evening last. Reports of officers and committees were listened to. The membership is steadily gaining, and the club is in a flourishing condition.

The *Illini*, the journal of the University of Illinois, at Champaign, says: "Quite a number of the mechanical engineering students will go to Chicago on April 24. They will be accompanied by Professor Wood and will visit the Northwestern shops, the North Side waterworks, the Western Electric shops, the Union Brass works, the rolling mills and other places of interest to an engineer."

Number 7 of Volume II of the Journal of the Electrical Society of Tokio, Japan, has been received at the office of the WESTERN ELECTRICIAN. It is a volume of over 100 pages, printed in the native language. Two papers by Prof. K. Shida are published and communications on "Thomson-Houston Lamps and Dynamos," by T. Hasegawa, and "Some Advantages of the Sounder," by W. B. Mason, are given. Considerable miscellaneous matter is also presented in the pamphlet.

Mme. Patti has always resolutely refused to sing into a phonograph, even for reproduction before the most exclusive audiences, says an exchange. The madame was recently outwitted in San Francisco, however, for one of Edison's agents caught the priceless notes of "Home, Sweet Home," on a waxen cylinder. He placed the machine underneath the stage among the gas pipes and connected it with the prompter's box, where the diva's voice fully penetrated. It would seem as if the phonograph is destined to arouse as much enmity among great artists as the autograph fiend.

Judge Sage of the United States court, recently imposed a sentence of $500 and fifteen months' imprisonment on a swindler who sold "electric" belts in Ohio. An English electrical journal says: "We could do with Judge Sage in this country as well as with the law he administers." It then goes on to state its inability to understand why the English law concerning the obtainment of money under false pretenses should be less operative in the case of the sale of a three-and-sixpenny flannel belt as a five-guinea article, warranted to exercise an utterly impossible influence, than it would be to punish any scoundrel who may wheedle a foolish servant girl out of her hard-earned wages by means of plausible falsehoods.

The Boston *Herald* says in reference to a new air pump invented by Adolph Berrenberg, of Somerville, Mass.: "This is not a glass pump, but a metal one, and in many respects a radical departure from the forms now in use. It is a machine for which failure has been predicted during the time it was planning and building by expert mechanics and those who were regarded as experts in such matters, it being held that, as metal was porous, such a pump could not be made to produce a vacuum. But the inventor thought he knew better, and the result has justified his perseverance. An exhibition of this pump was given at 109 Purchase street yesterday to a number of gentlemen, among whom were several representatives of the press. In their presence a vacuum was produced in glass bulbs in five minutes more completely than could be obtained in the glass mercurial pumps in as many hours, and prepared glass bulbs, with carbon filaments, were exhausted in about one minute so completely that they could be lighted without danger of destruction to the filament. Not only is this new pump effective in its work but it has such a great power of exhaustion that it will do alone what would require hundreds of mercurial pumps to accomplish. It can exhaust 100 lamps to a point at which electricity can be turned on to the carbons in not over one minute."

An interesting description of a scheme for killing rats by electricity is given in the *American Miller*. It seems that the engineer in a certain mill was troubled greatly by the depredations of rats. The rodents were very plentiful in the mill and were wary, having become educated to a full knowledge of traps, cats and poison. In desperation the engineer hit upon a scheme by which, through the aid of electricity, he was enabled to thin very materially the ranks of the enemy. The rats, as the story goes were in the habit of getting in and out of the mill through a hole in the brick wall, where a steam pipe ran from one building to another. The pipe was well covered with an asbestos coating, making a nice warm runway for the rats in cold weather. Two brass bands were put around the steam pipe, about 4 inches wide, each band, and 2 inches apart. These bands were then connected respectively with the + and − wires of the mill incandescent light circuit. The first rat that scuttled over the pipe got all the electricity he wanted It paralyzed him the instant he touched both pieces of brass. Instead of falling off the pipe, however, the rascal lay right still and sizzled and cooked, and short-circuited the wires. Here now was an unlooked-for difficulty. Electricity would do the work well enough, but one short circuit per rat, to say nothing of a number of lights extinguished—this would never do. At last, however, after a number of experiments our enterprising engineer produced a trap which, as he expresses it, "proved double acting, automatic, and saved fully 33⅓ per cent. of fuel used." A small converter was borrowed from the alternating electric light station. The secondary of this was connected in the circuit along with a commutator, which was rigged to break continuously the circuit at the rate of 1,280 times per minute. The primary or fine wire coil in the converter was then attached to the brass bands on the steam pipe. This arrangement worked to a charm. While the rats did not come up by the hundred to be killed, more than forty of them died by electricity in two nights. When a rat sticks on the bands, after being hit, a bell rings, and he is taken away.

Business Mention.

George B Prescott, Jr., has been engaged to handle the Day wires, with headquarters at 16 Dey street, New York.

The Electric Construction & Supply company of New York reports that the new lamp for low tension incandescent circuits is meeting with great success. It is stated that over 200 of these lamps are giving entire satisfaction on the Edison system in New York.

The Columbia Incandescent Lamp company of St. Louis have opened an office in Chicago in charge of Mr. E A. Frizzell, who has been connected with the company at St. Louis since it started. He reports business as quite brisk, and the outlook as very promising.

The North West Electric Supply & Construction company, of Seattle, Wash., have just contracted to place the Partrick & Carter system of annunciators and fire alarms in the new Denny Hotel at Seattle. The annunciator will have nearly 300 numbers on it, and the rooms will have return calls to the office. The new Park Hotel, Hot Springs, will be supplied with a similar system by the same company.

Among the recent sales of engines by A. L Ide & Son, of Springfield, Ill., are the following: Village of Sleepy Eye, Minn., 1 25-horse power engine; Duluth South Shore & Atlantic Railway company, Marquette, Mich., 1 70-horse power engine; Otto Young & Co., jewelers, Chicago, 1 45-horse power engine; E. Partridge, Chicago, (second order), 1 100-horse power engine; John Kranz, Chicago, (second order), 1 45-horse power engine; Boonville, Mo., Electric Light company, 1 80-horse power engine.

The Interior Conduit & Insulation company of New York city, have taken up the question of underground conduits and have sold the system for Detroit to the Electric Light & Power company of that city. The following abstract from a letter written by Frank Kitton, insurance inspector of Buffalo, N. Y., and chief operator of the Western Union Telegraph company, explains itself: "The use of your conduit tube provides great immunity from the dangers that may arise through the development of excessive heat in conductors of electricity, protects the wires from mechanical injury, and excludes moisture. The system is so flexible, and possesses such engineering advantages as to commend its adoption to those seeking a systematic method of providing for the wiring of buildings in the course of construction, as well as to others, more especially concerned in the safety of electric light and power installations."

Electrical Patents.

Issued April 8, 1890.

424,993. Telephone Toll Box and Connection Register. Charles E. McCluer, Richmond, Va.

The last claim is given:

"5. In combination with an escutcheon and a coin tube or chute, fixed and adjustable electrodes arranged within apertures made in the sides and edges of the tubes, with a switch-lever attached to and operating the adjustable electrodes."

424,995. Switch Board. Edward A. Owen, East Saginaw, Mich.

424,997. Electric Stop Motion for Warping Machines. John E. Prest, Northbridge, Mass.

425,004 Electric Alarm Device for Clocks. Robert Schmitz, Cleveland, O.

425,038. System of Telpherage. James E. Maynadier, Taunton, Mass.

Claim four reads:

"In a system of telpherage, a car combined with a plurality of sets of supports attached to it, in combination with a plurality of pairs of tracks, each set of supports supporting the car upon one pair of tracks until the plane of that pair of tracks shifts, as described, to bring another set of supports into operation on another pair of tracks."

425,056. Machine for Weaving Insulating Coverings on Electrical Conductors. Charles T. Stetson, Hanson, Mass.

425,058. Telephone Switch. Ernest P. Warner, Chicago, Ill.

Claim two is as follows:

"The combination, with the pivoted telephone hook or support having two lugs or bearing-pieces provided upon the under side thereof, one of said bearing-pieces being of insulating material, and the other of metal, a spring secured at one end under said lever and having its free end extending backwardly under said bearings to permit said bearings to alternately rest upon different portions thereof as the lever is rocked or vibrated, whereby the electrical connection between the spring and lever is opened and closed alternatively as the bearings are brought against different portions of the spring."

425,061. Lightning Arrester. James D. Bishop, Chicago, Ill.

425,066. Balanced Pen for Autographic Telegraphs. Harry Etheridge, Pittsburg, Pa.

The invention consists in the combination, with the receiving stylus or rod of an autographic telegraph, or a fountain pen nib pivoted to said rod and having its writing point limb made slightly heavier than the other, and a reservoir separate from the nib.

425,068. Voltmeter. Madison M. Garver, Newark, N. J.

425,069. Ammeter. Madison M. Garver, Newark, N. J.

425,071. Pole for Electric Wires. Levi R. Greene, Boston, Mass.

425,076. Electrically Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa.

The object of the invention is to provide an electrically propelled vehicle, with means for arresting its movement in the form of an electrically actuated brake. The motor and brake are operated from the same source of electric power, which may be either line-conductors or batteries.

425,077. Electric Railway Car. Rudolph M. Hunter, Philadelphia, Pa.

Of the sixteen claims the tenth is given:

"The combination of two axles, a car body or frame supported thereon through springs, a motor elastically supported on the axles independently of the car body, and toothed gearing between the motor shaft and axle."

425,078. Electrical Annunciator Drop. Martin Hynes, Boston, Mass.

425,086 Central Office System for Autographic Telegraphs. James H. Robertson, Rutherford, N. J.

The last claim follows:

"3. The combination, with a number of conductors terminating in a central or exchange office, of a battery, electro-magnet and armature, and a pile of carbon disks, all arranged in the conductor for connecting the circuits, the armature being mounted to exert more or less pressure on the pile of disks as the strength of the current decreases or increases."

425,089. Thermostat. William F. Singer, Carthage, N. Y.

425,101. Support for Electric Railway Conductors. Conrad J. Kilian, Milwaukee, Wis.

The seventh claim follows:

"The combination, with a pair of posts, of a truss consisting of an arched cross brace and a cross wire or rod attached at the ends to said posts, and an electric conductor suspended from said truss by a suitable hanger."

425,106. Electric Rotary Pump. Emory I. Nichols, San Francisco, Cal.

425,107. Device for Shielding and Protecting Wires. Herbert E. Penney, Minneapolis, Minn.

The invention consists in the combination, with a wire, of a flexible trough shaped guard composed of insulating material having sides extending below the wire.

425,125. Electric Lighting and Advertising System. Arthur Douglass, Danes Inn, Strand, County of Middlesex, Eng.

425,135. Electrode for Galvanic Batteries. William P. Kookogey, Brooklyn, N. Y.

425,143. Burglar-Alarm. John Moran, Adair, Mo.

425,161. Telephone Toll-Box. Harry L. Cassard, Baltimore, Md.

425,164. Method of Electric Welding. Charles L Coffin, Detroit, Mich.

The process consists in placing the articles to be welded in contact, connecting them with opposite poles of a generator of electricity, passing a heating current through them, simultaneously traversing the joint with an electric conductor, one end of which is connected with one pole of the generator, and the other end in contact with the joint, and finally completing the weld by pressure.

425,205. Switch. Arthur R. Bush, Boston, Mass.

425,269. Electric Meter. Milton E. Thompson, Boston, Mass.

The invention relates to an electric meter dependent upon the heating effect of the current, and consists in the combination with any device for registering said heating effects, of a plurality of heating coils producing two heating effects, whose difference shall be proportioned to the electrical energy which is to be measured.

425,270. Electric Meter. Milton E. Thompson, Boston, Mass.

The invention consists, first, of an arrangement of coils, resistances and wires, whereby a heating effect is produced proportional to the electrical energy to be measured, and second, of an apparatus for measuring this heating effect, said apparatus consisting of a differential thermometer dependent upon the expansion of a gas or liquid, and producing an autographic record.

425,335. Process of Manufacturing Metallic Electrodes for Batteries. Friedrich Marx, Berlin, Germany.

The process consists in purifying from the presence of salts the metallic deposit obtained by the electrolytic process or by precipitation with other metals and then rolling into the mass so purified, a wire-woven fabric or metal plate.

425,388. Electric-Railway Apparatus. John B. Odell, Chicago, Ill.

The object of the invention is, first, to improve the construction of the conduit, within which will be placed the conductors for current, and within which will travel the contact brushes or wheels that serve to deliver current from the conductors to the motors upon the cars; second, to improve the construction of the arm that carries the contact brushes or wheels and the means for sustaining and operating said arm from the car; third, to provide improved means whereby the movement communicated from the motor of the car to the driving wheels can be graduated, in order to permit the easy starting and stopping of the car without necessarily diminishing the speed of the motor.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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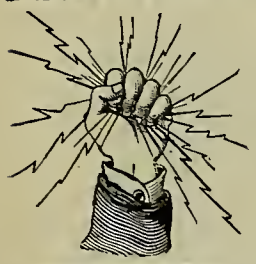

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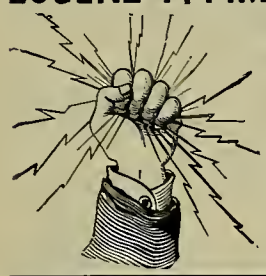

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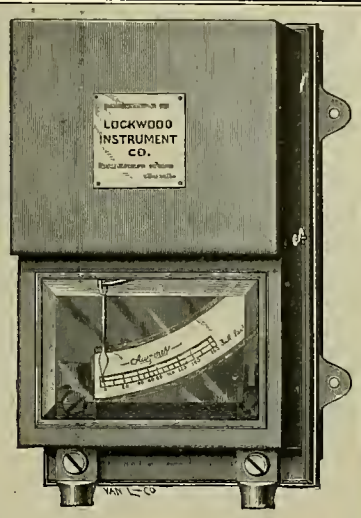

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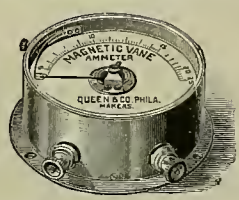

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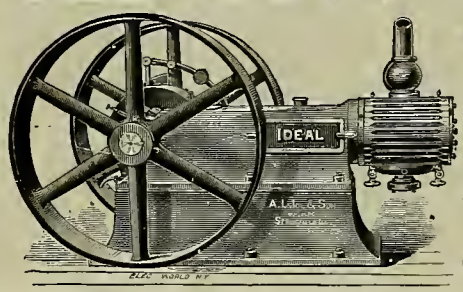

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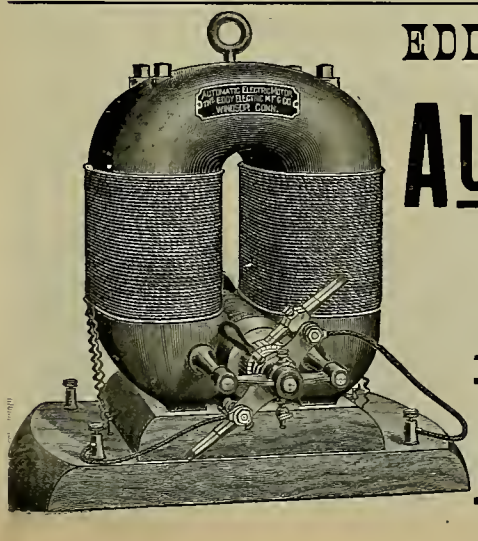

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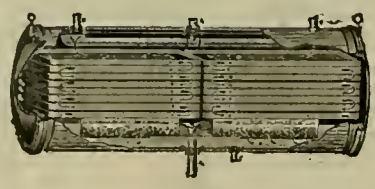

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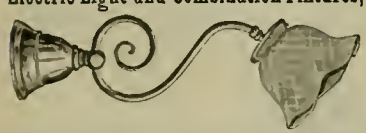

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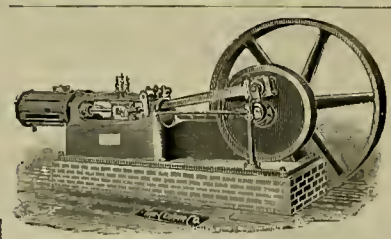

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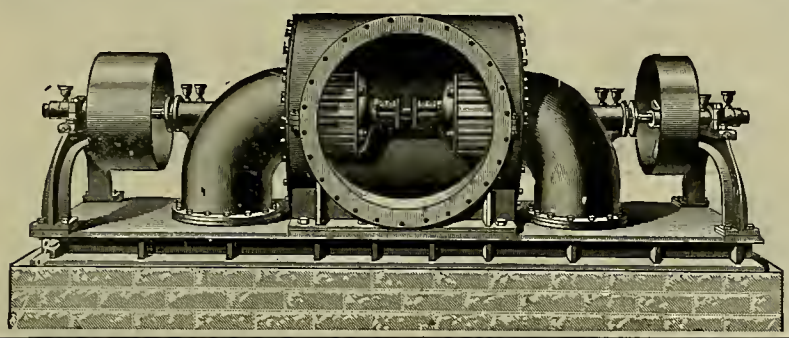

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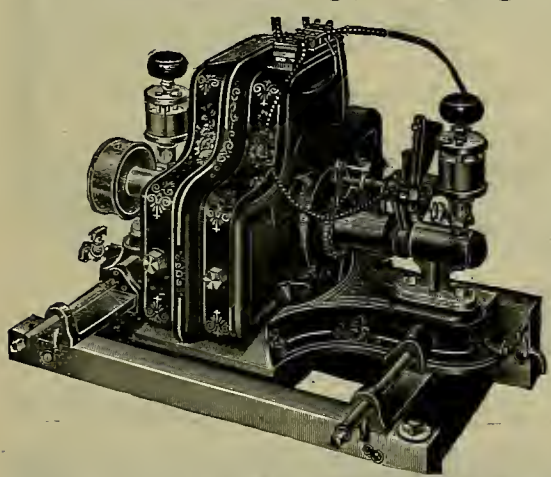

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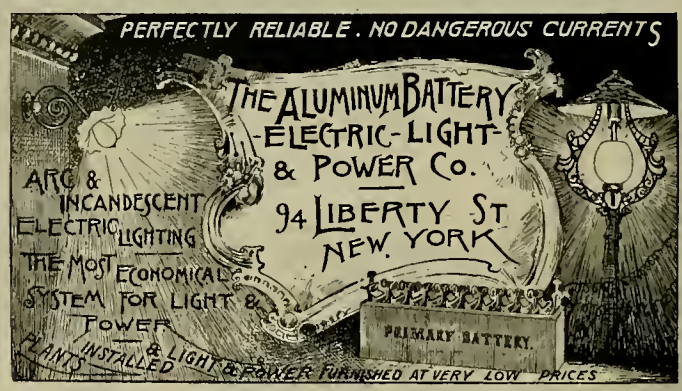

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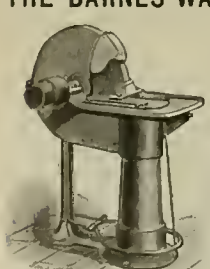

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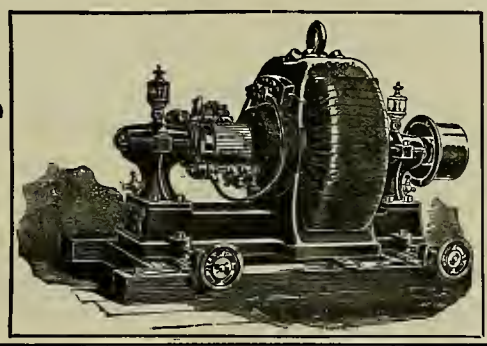

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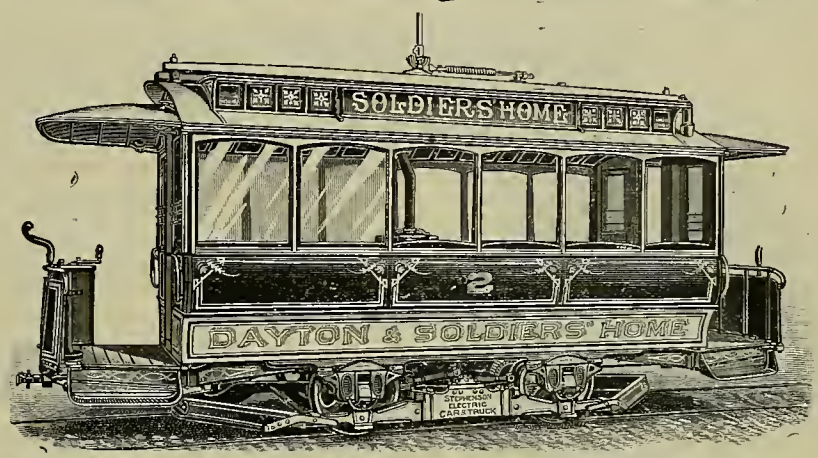

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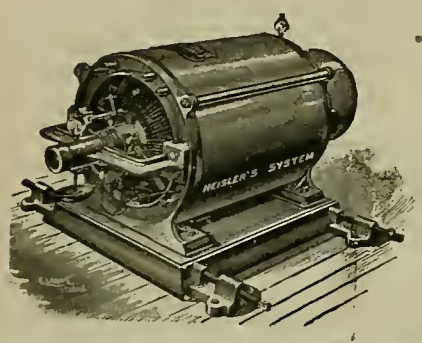

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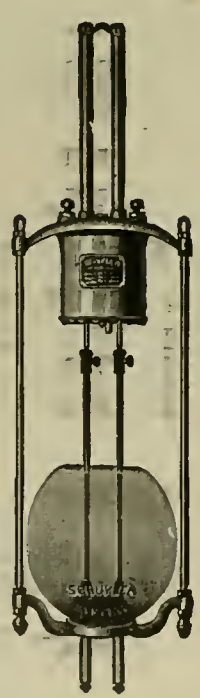

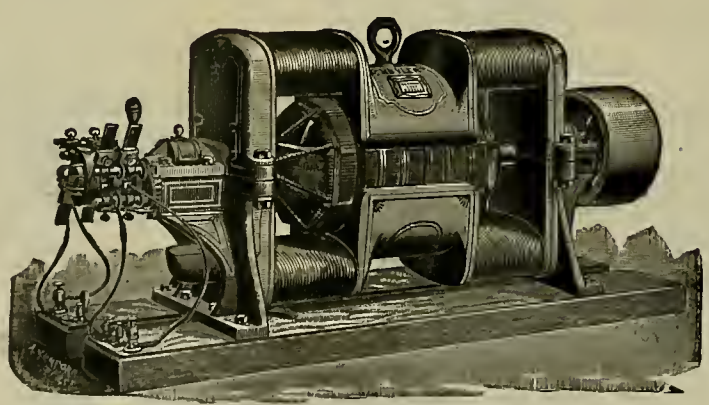

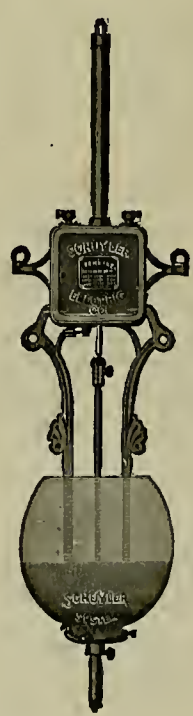

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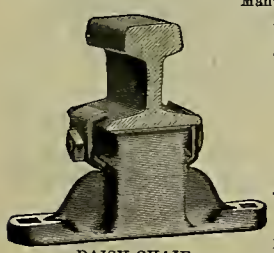

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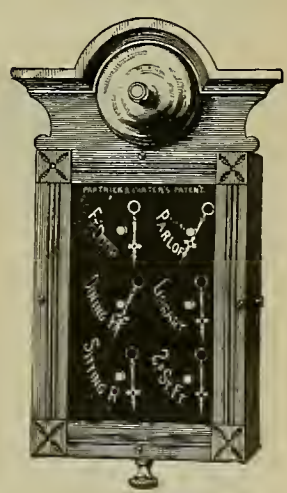

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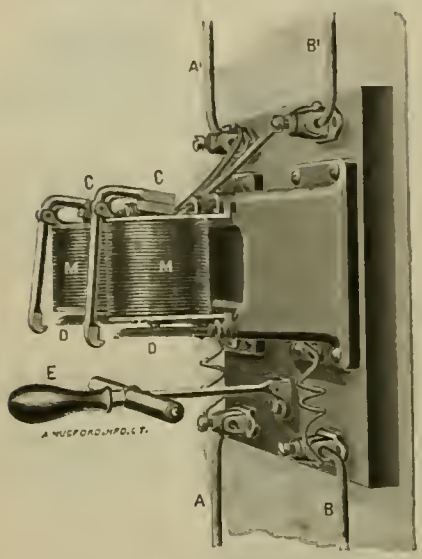

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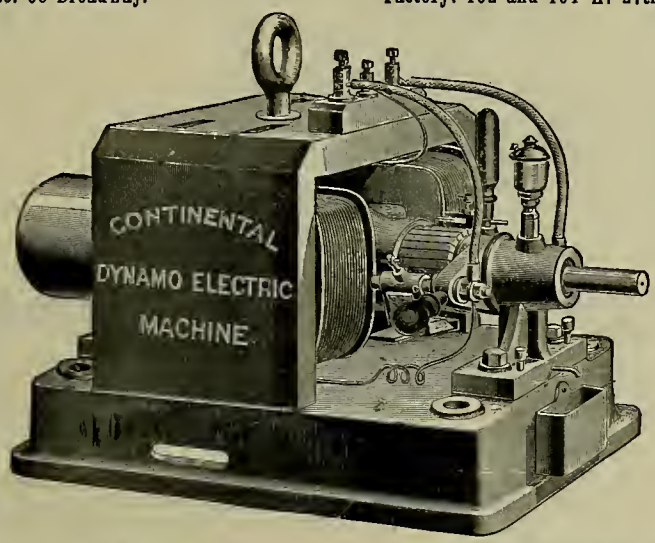

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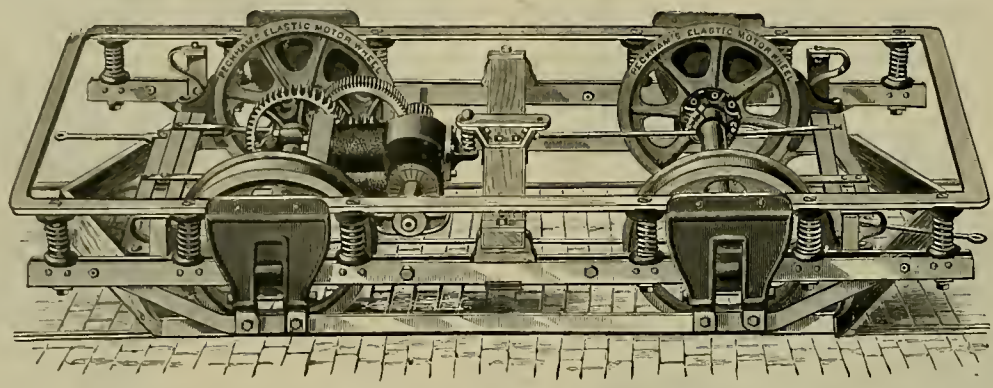

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The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:--

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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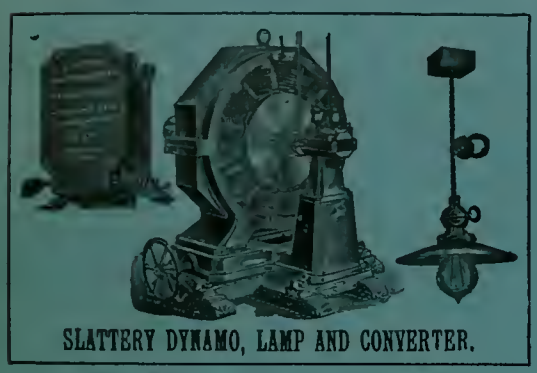

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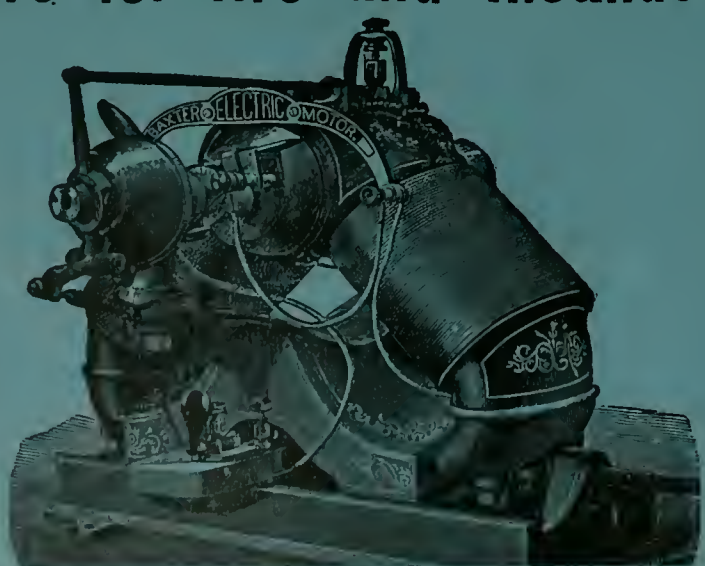

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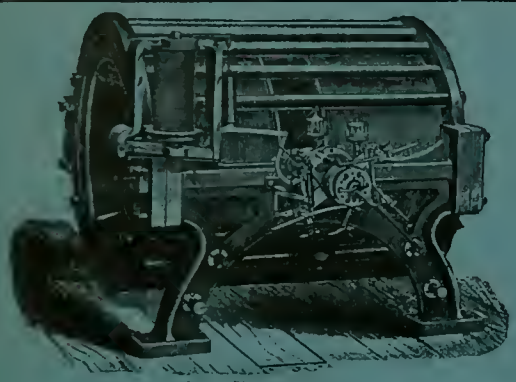

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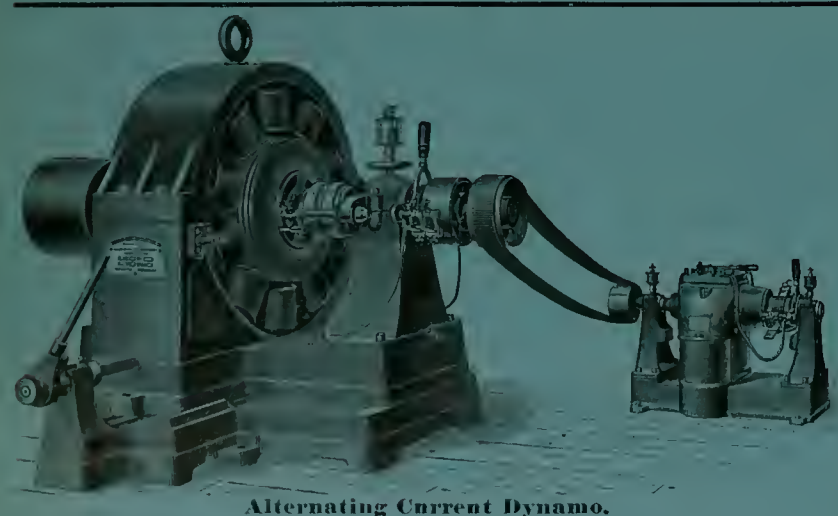

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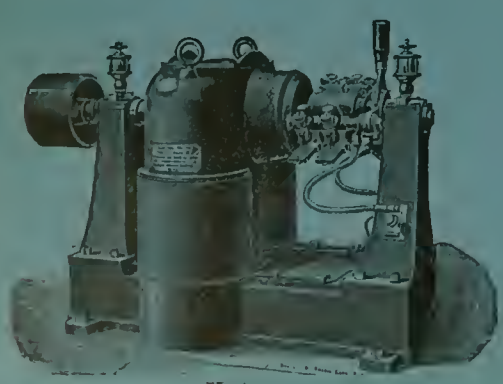

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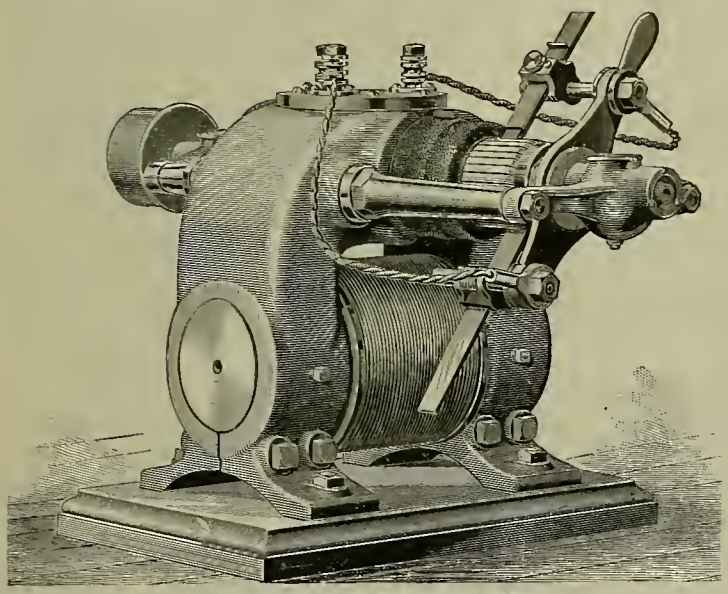

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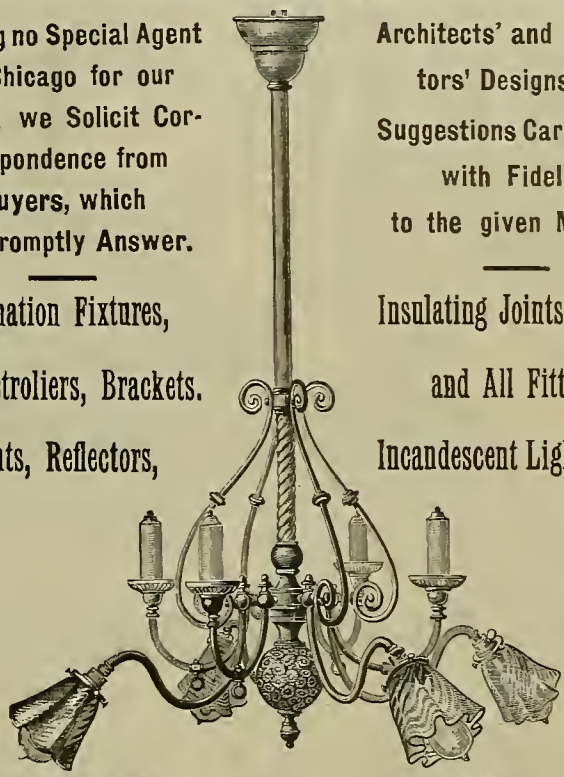

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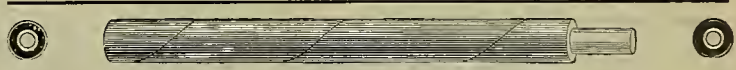

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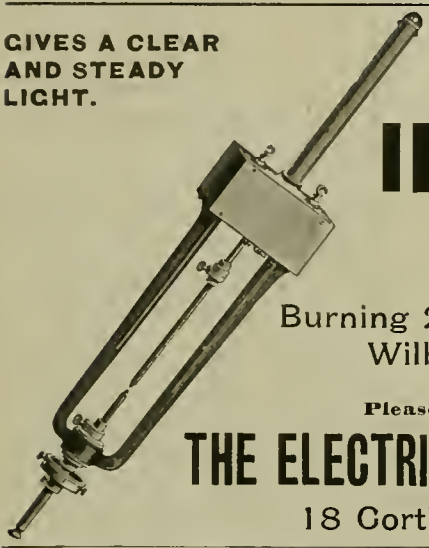

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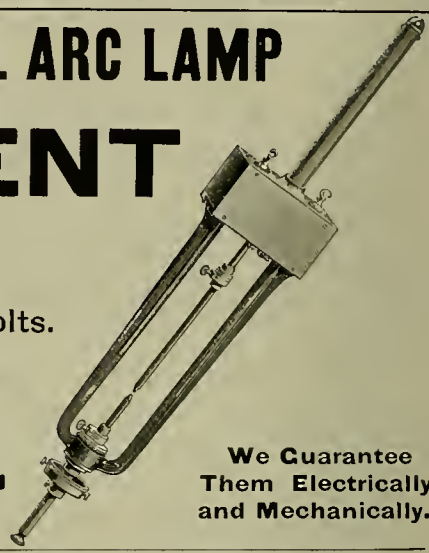

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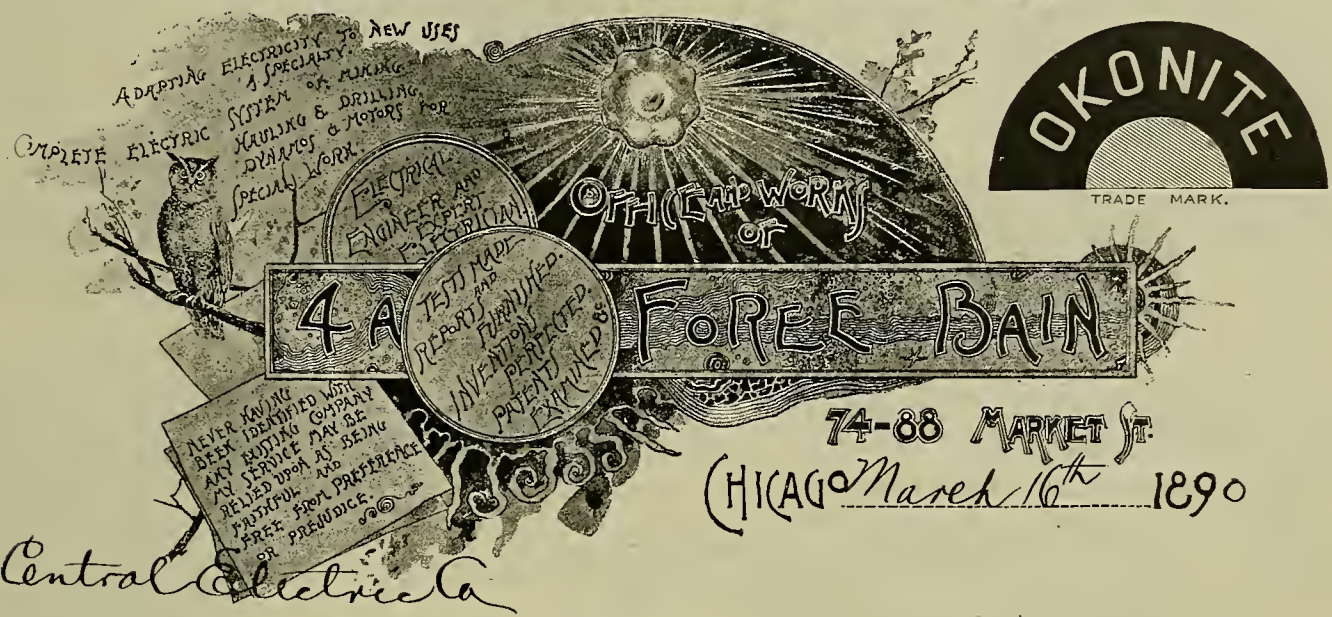

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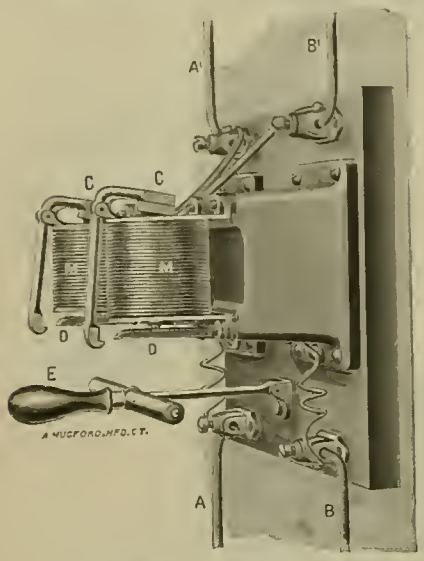

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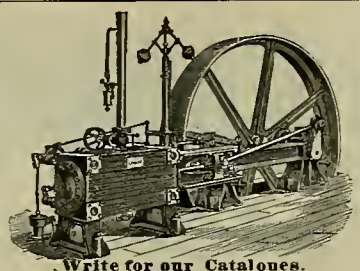

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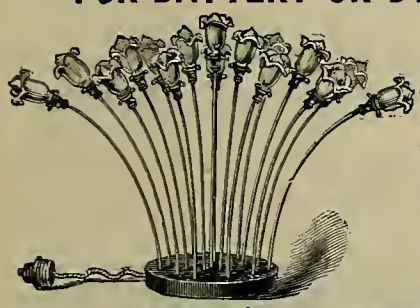

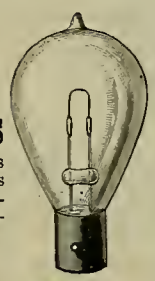

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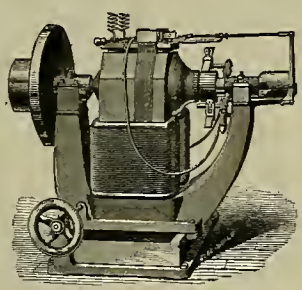

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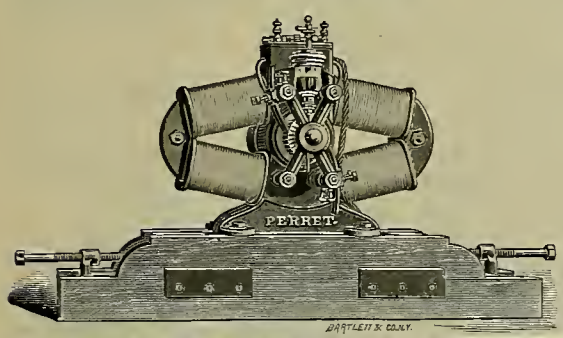

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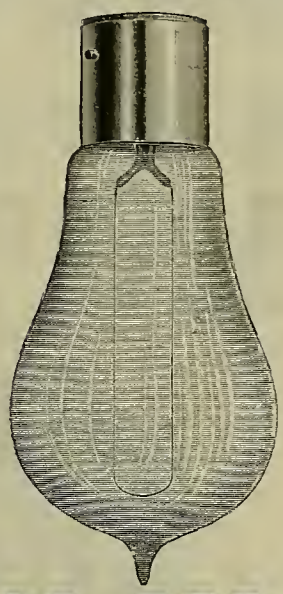

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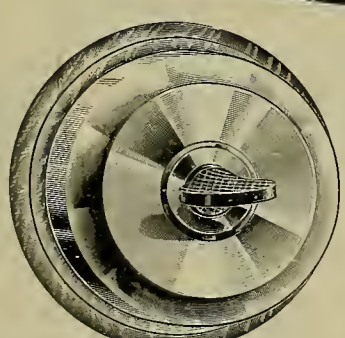

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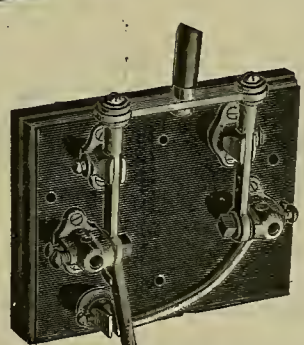

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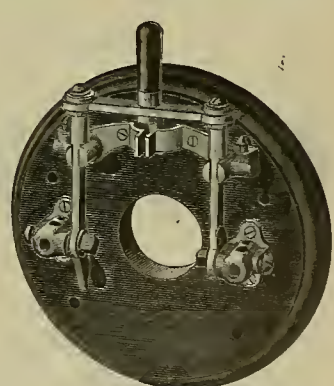

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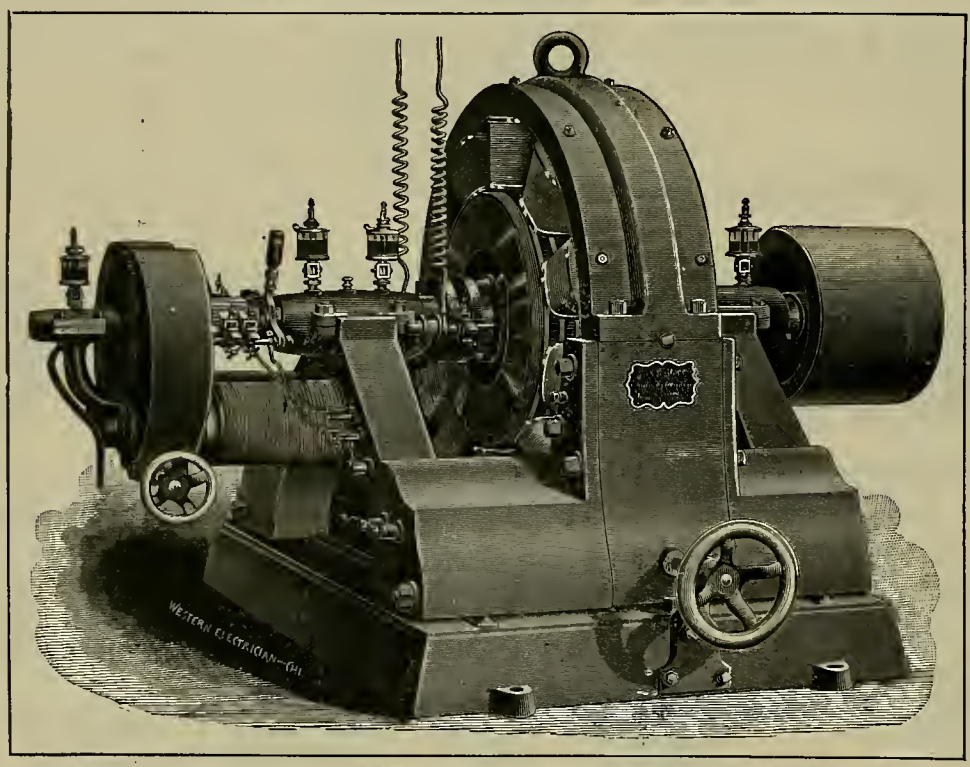

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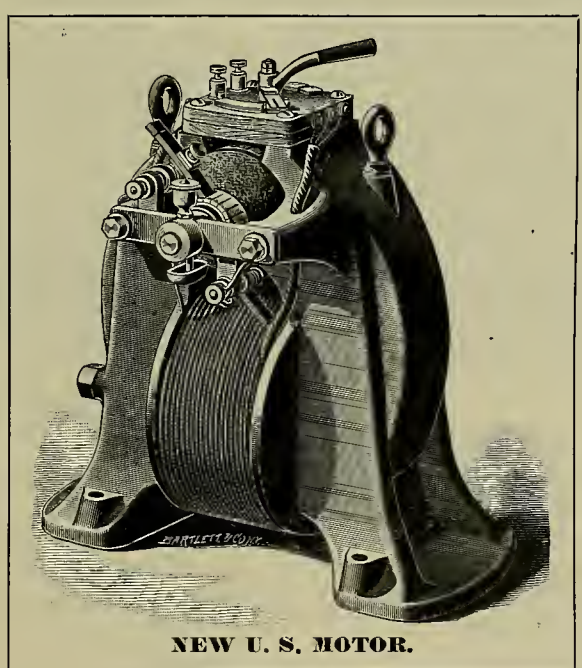

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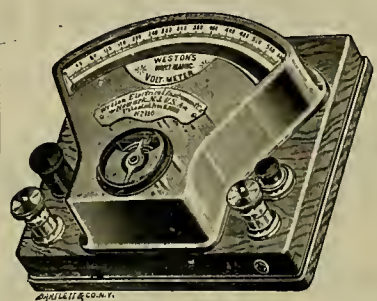

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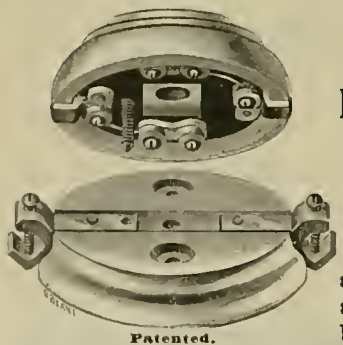

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Vol. VI. CHICAGO, APRIL 26, 1890. No. 17

Electric Lighting Plant at Chariton, Ia.,

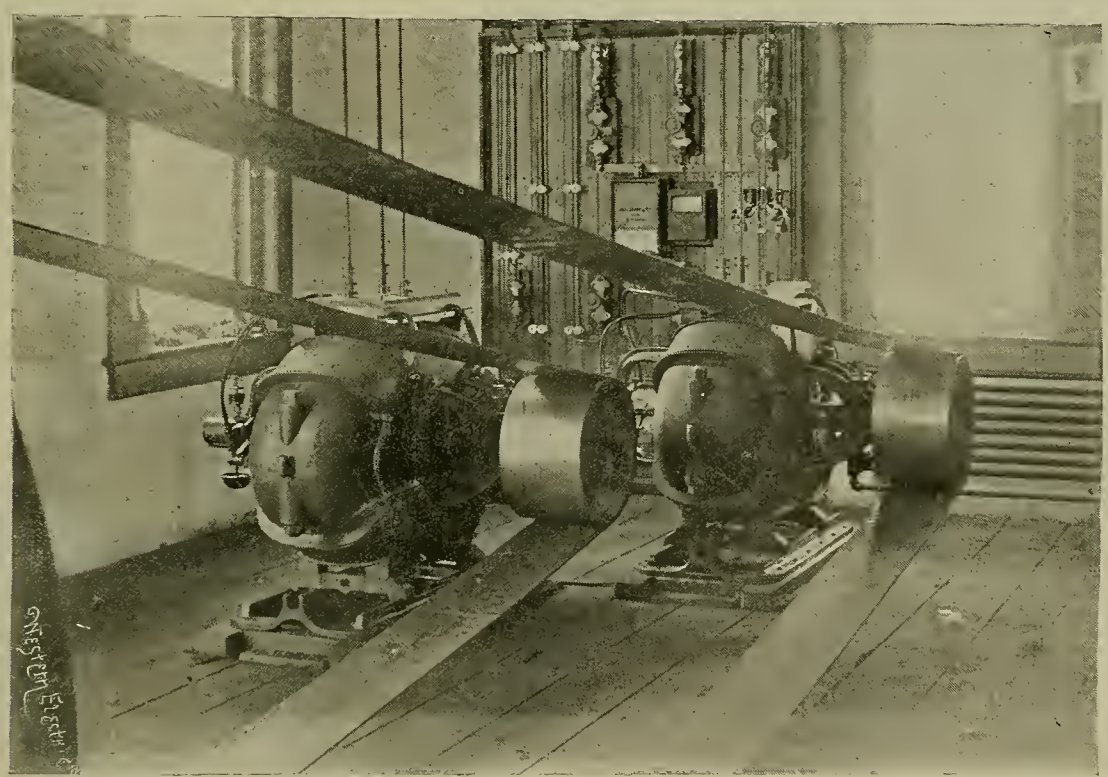
The city of Chariton, Ia., last fall, voted to bond the municipality in order that an electric lighting plant might be established. The contract for the lighting plant was awarded to the Hawkeye Electric Manufacturing company of Davenport, Ia., and the plant is now completed and is in successful operation. The accompanying illustration gives a view of the dynamo room. The electric light plant consists of two Hawkeye incandescent dynamos of the new type.

The generators were guaranteed to generate current for 500 lights each, but before the plant was accepted a load of 1,100 lights was put on the machines for an entire evening. The dynamos operated during the test to the entire satisfaction of the city officials. The machines are so connected that one or both may be operated as the demand may require. They are coupled in multiple.

The power for operating the engines is derived from a Myers engine of 120 horse power which obtains its steam from two steel boilers of 75 horse power each.

The plant is located in a substantial two-story brick building, which was erected by the city especially for the central station. The upper story is arranged as an observation gallery. Visitors are always welcomed, and they have an excellent opportunity of observing the plant from the gallery.

The city employs for street illumination 100 32-candle power lamps, which are suspended in the middle of the principal thoroughfares. The city supplies stores and residences with lights to the number of 1,000. The price for light is calculated on the cost of operating the station and the interest on the investment. It is not intended that a profit of the station shall be made.



ELECTRIC LIGHT PLANT AT CHARITON, IA.

Proposed New Telegraph Line.

The Chicago Board of Trade is having considerable trouble of late, most of which it has invited by the rash action of its board of managers. When the managers decided to cut the board off from the outside world and stop the quotations, it ordered the Western Union Telegraph company to remove its wires and instruments, etc. Of course, the action of the board cut off considerable business, and in order to continue efficient service without loss, the telegraph company raised the rate. This aroused considerable indignation on the part of the members of the board, and a number of them threatened to establish a competing line to New York city. This, it is generally conceded, would scarcely prove a profitable investment, and it is hardly probable that such a project will be executed.

Chicago City Electric Plant.

The Chicago city council in its appropriations this year "lumped" the light fund, making it necessary for the electrical department to be extremely economical in order to get a fair sum for construction work in the extension of the electric light plant. City Electrician Barrett says he expects to begin work at an early day, however, and he believes about $220,000 will be expended on the plant. He hopes that the gas lamps supplanted in the districts lighted by electricity will not only pay for the operating expenses of the present stations, but leave something for construction of the city electric light plant. During this season he will direct his attention to establishing a South side station, and adding to the present North and West side plants. No new city stations will be established this year, as the South side plant cannot be looked on as new plant. All the underground work was done last year, and an effort will be made to have the Commissioner of Public Works hurry the new building to a speedy completion. The plans have been completed, and everything is in readiness.

Edison has recently been granted a patent on a commutator and brushes having amalgamated contact surfaces. He claims that the amalgamated surfaces have such an affinity for each other that the resistance of the contact to the passage of the current is low and the spark is very much reduced. As sparking occurs as the commutator bars break circuit with the brushes, the mercury performs the function of carrying off the spark heat by its vapor.

Henry B. Stone, President of the Chicago Telephone Company.

Henry B. Stone has been selected president of the Chicago Telephone company and the Central Union Telephone company. He will assume his new position June 1st. Mr. Stone is 35 years of age, a graduate of Harvard, and a gentleman of ability and experience. He has been practically at the head of the Chicago, Burlington & Quincy system since the great strike, and in that contest he showed a strength of character that was truly marvelous.

When Mr. Stone finished his education he entered the C., B. & Q. shops, and passed through the mechanical department mastering all the grades, until he became division master mechanic at Aurora. In 1880 he was appointed superintendent of the locomotive and car departments, and in 1881 became general superintendent. Two years later he was made assistant general manager, and shortly afterward was promoted to general manager. Upon the termination of the strike he was made second vice-president, in charge of the operating and traffic affairs of the entire Burlington system. His administration of the affairs of this corporation gained for him the reputation of being one of the ablest railroad managers of the country. The end of the conflict between the company and its engineers which engaged the attention of the country, left the financial affairs of the company not only greatly involved, but the system thoroughly demoralized, its losses amounting to three or four millions. Undismayed by these facts, Mr. Stone set to work to repair the fortunes of the company. How well he succeeded was shown by the last annual report. Not only was all the debt wiped out, but there was enough surplus at the end of 1889 to pay a dividend of 4 per cent., and the statements for January, February, and March of this year show that the improvement is still going on. The company is almost as well off to-day financially, in spite of frequent rate wars, as it was when the strike was first inaugurated.

It will, therefore, be readily recognized that in the selection of Mr. Stone the telephone companies secured a man of great executive ability, whose knowledge of men and affairs will prove of inestimable value in the direction of the affairs of these important corporations.

National Direct Current Dynamo.

The new form of direct current dynamo, which has recently been put on the market by the National Electric Manufacturing company of Eau Claire, Wis., is illustrated in Figs. 1 and 2. The general construction of the machine is not materially different from other well known types. The design is substantial, and while it

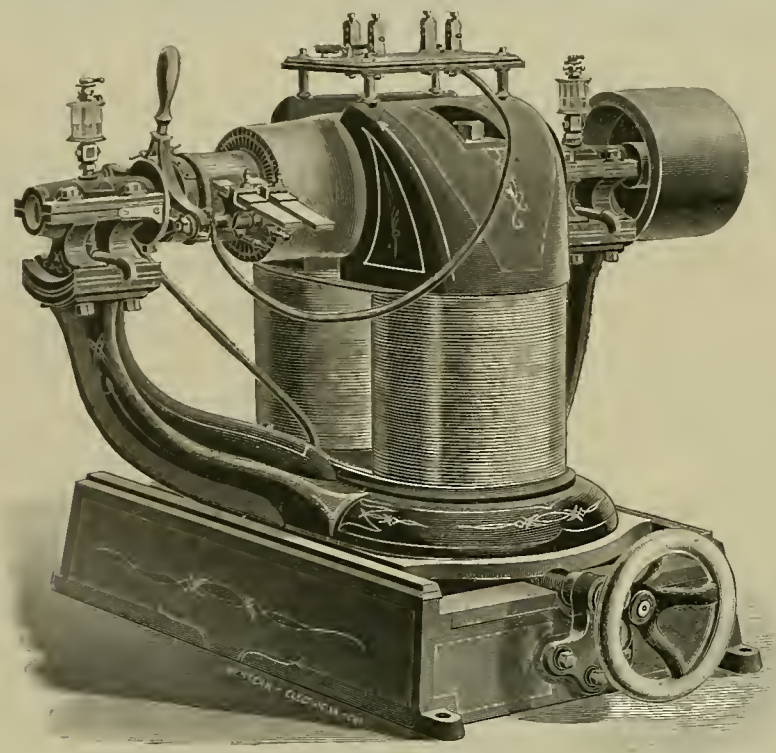


FIG. 1. NATIONAL DIRECT CURRENT DYNAMO.

embodies all the latest features in incandescent dynamo work, the mechanical and electrical construction has been very much simplified.

The armature, which is of the Siemens type, is wound in a peculiar manner, and as a consequence, the size of the butts or ends is greatly reduced.

The winding of the machine, it is stated, is so calculated that all sparking at the brushes is eliminated. Only one layer of wire is used on the armature.

The bed plate and journal supports are cast in one piece, thus insuring rigidity. The field magnets are secured to the base by means of bolts passing through the entire length of the magnets. Two dowel pins prevent shifting of the magnets and also insure the proper position of magnets when the machine is assembled. The field magnets and seats for the journal boxes are bored at one operation and the bases of the boxes are turned to a corresponding diameter so that the journals can never become out of line. The armature can be easily removed if required, by simply taking off one journal. The machine is provided with adjustable sight feed oilers of an improved design.

The commutator is made up of drop-forged copper bars, and is insulated throughout with mica. The hard wood table on top of the machine contains binding posts for the reception of the main wires and safety fuses. The brush holders are of a new design, and are provided with adjusting springs by means of which the tension of the brushes may be varied within wide limits. The holders are adapted for brushes from one-fourth to one-half inch in thickness.

The dynamo proper is mounted on a sub-base or sliding frame of iron provided with screw and hand wheel, by means of which the tension of the belt may be adjusted as required.

Fig. 3 shows a curve of the e. m. f. taken from a 100 ampere, 100 volt over-compounded dynamo at a speed of 1,350 revolutions per minute. This machine was designed to supply 200 lights of 100 volts with a drop or loss in the wiring of two volts. How well the object sought for has been accomplished, the diagram shows. These machines may of course be used as motors if desired. The company claims an efficiency of 96 per cent. for all machines of over 50 amperes capacity.

Electric Lighting in Berlin.

Emil Rathenau, general director of the General Electric company of Berlin, was in Chicago on Monday last. He has been in America a little over three weeks, most of which time he has been with Henry Villard, president of the General Edison company. He has kept on the go, and though he is taking the trip mainly for pleasure, he is devoting himself industriously to the inspection of electric light and power plants. Speaking of his trip Herr Rathenau said to a representative of the WESTERN ELECTRICIAN:

"I have been greatly interested in electric railways in America. We of course have no such railways on the other side. Our company has acquired the rights for the Sprague system for all Europe, except England and France. We are about to introduce electric railways of the American system in all the great cities of Germany. I have been greatly interested in inspecting Edison plants. Our company, as you may know, is a shareholder in the parent Edison company. The machine works at Schenectady and the lamp factory are models, and, in my opinion, are superior to anything in the world."

When asked to speak of electric lighting in Berlin, Herr Rathenau said:

"The prospects for extension of electric lighting in Berlin are extremely favorable. Our company now has four stations; at the end of this year these stations will furnish current for 100,000 lamps. Before next year is ended 180,000 lamps will be supplied. The engines which we use are all compound condensing. They were built by Van der Kerchove, of Ghent, Belgium. They are of the Corliss type and they are connected direct to the dynamos. The dynamo speed is slow—68 revolutions per minute. The economy of these engines is very marked, with 115 pounds' pressure only 11 pounds of steam is required per horse power hour. We get an indicated mechanical efficiency of 95 per cent. at the dynamo, so we lose in our dynamos and engines only 15 per cent. To give you an idea of the condensing water used in the stations, I will say that in a single station as much condensing water is used as is required for a city of 150,000 inhabitants. We get this water from artesian wells, of which we now have sixteen. To get rid of the water we use pipes about two feet in diameter. The first station was opened in 1884 with 5,000 lamps. We have recently made a municipal contract, according to the terms of which we must increase the capacity to 28,000 horse power. We will use in extending the system accumulator sub-stations. The accumulators will be charged during the day and at night the central stations and sub-stations will give us a capacity of 1,200,000 lamps. We determined to use accumulators after we had tested the Tudor storage battery. This battery has been tried for seven years in the central station at Darmstadt and other places, and has given excellent results. Our company and Siemens & Halske, the noted electric firm, bought the battery. The latter are putting up a factory for the manufacture of the batteries, at a cost of five million marks. The battery, I may say, is formed to a certain extent, like the old Plante battery. We have the greatest confidence in this system of distribution by storage battery sub-stations. We expect to show that it is economical to light a large territory by this means."

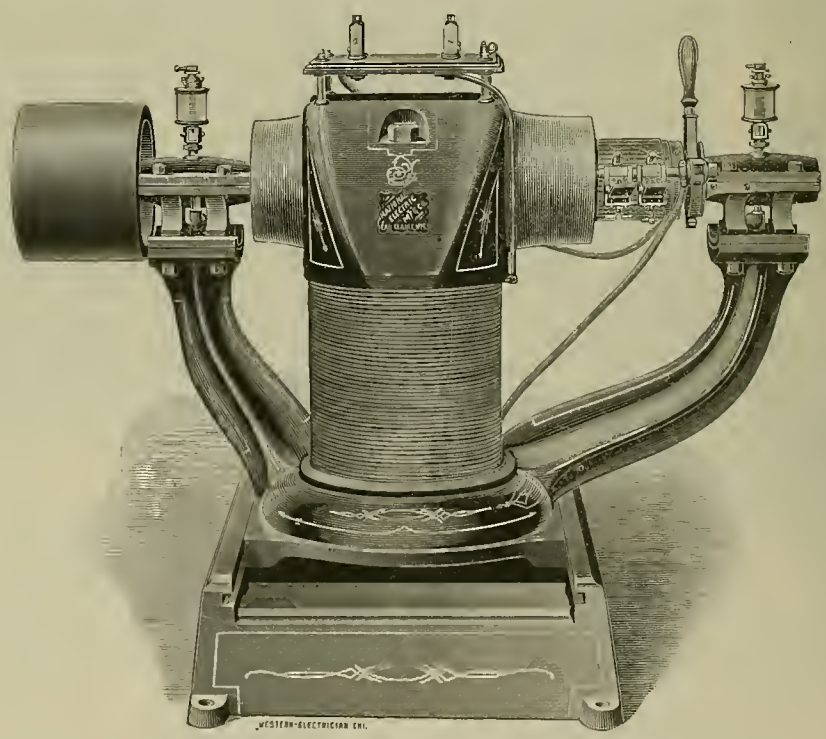


FIG. 2. NATIONAL DIRECT CURRENT DYNAMO.

The Rochester, N. Y., Electric Railway company has determined to establish a line on East avenue, the most fashionable drive in the Flower city, provided it can secure the right of way. Many efforts have been made to establish a horse car line on this thoroughfare, but without success. The present movement is favored by the property owners on the avenue.

Death of E. S. Hewson, Chicago.

The announcement of the death of E. S. Hewson, Chicago, will be received with universal regret by his old associates. Mr. Hewson was attacked by la grippe during the holidays, suffered a relapse, and never recovered. He sank rapidly during the last few weeks and died Saturday night, April 19th. He was attended throughout his illness by his wife and at the time of his death his parents and brother were also present. The body was taken East, the interment being made at his old home, Newark, N. J. Mr. Hewson was 28 years of age. He was born at Newark, N. J., and was educated there. He entered his father's factory but continued his studies, devoting much attention to chemistry and mechanics. He became interested in electrical matters and entered the factory of the old Weston company at Newark. When the United States company assumed control of the Weston business and established an office in Chicago, Mr. Hewson was sent out as an expert and continued in that capacity for a number of years. For a time he was stationed at Philadelphia but returned to Chicago in 1886 and was soon promoted to the position of superintendent of construction, which he held at the time of his death. When the Westinghouse company assumed control of the United States company's business Mr. Hewson was one of the few men continued at the Chicago office. Although a young man, Mr. Hewson was looked upon as one of the pioneers in electric lighting in Chicago. He was a member of the Chicago Electric club, and had done much to contribute to the success of the organization.

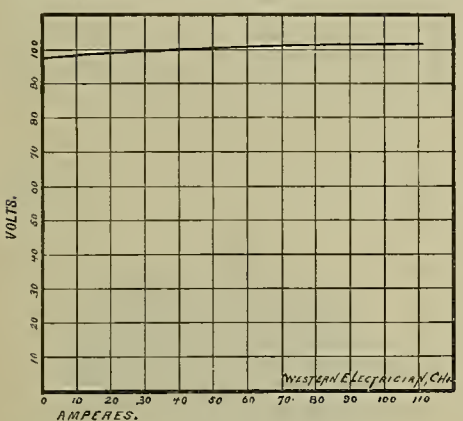


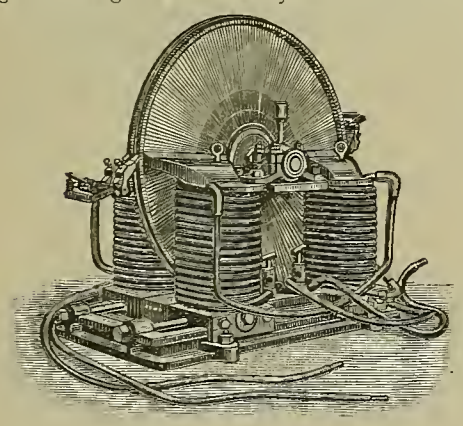
FIG. 3. NATIONAL DIRECT CURRENT DYNAMO.

Mr. Hewson was married about a year ago at St. Louis, to Miss Josie Slattery of that city.

At a meeting of the board of managers of the Chicago Electric club April 22, a committee was appointed to take suitable action on the death of Mr. Hewson.

Polechko's Dynamo.

The cut presented herewith illustrates the general design of a new disk dynamo constructed by M. Polechko and described by him at the eighth congress of Russian naturalists.



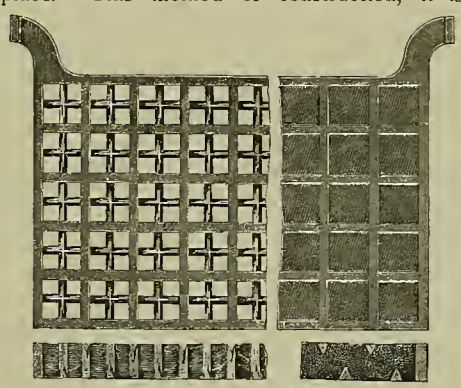
POLECHKO'S DYNAMO.

The inventor seems to have attempted to design a commercial dynamo on the principle of Barlow's wheel. The armature of the machine is made from a single piece of metal, one meter in diameter, insulated from the shaft, and cut radially into 350 segments separated from one another by fiber to within thirteen centimeters of the shaft. The periphery of the disk is furnished with a steel rim, insulated from the disk itself, and widened out on either side of the disk, so as to serve as a collector. The first machine of this type made by M. Polechko gave 25 volts and 2,000 amperes when running at 1,500 revolutions per minute; its weight was 1,140 kilos.

M. Polechko is engaged upon the construction of a new pattern of his machine, which will be almost of similar dimensions, but will be furnished with a metal more suitable for the magnetic circuit.

Correns' Accumulator Plate.

There are at least three claimants for the invention of that general form of accumulator grid shown in the accompanying cut. A plate almost identical to that shown in the illustration was patented by H. G. Osburn of Chicago a few months ago, and was illustrated in the WESTERN ELECTRICIAN of Jan. 14 last. An English paper which commented on the article stated that a plate substantially the same as that of Mr. Osburn had been patented by J. S. Sellon of England. The cut here shown is reproduced from the *Elektrotechnische Zeitschrift*, which speaks of the plate as the essential feature of a new accumulator recently constructed by E. Correns of Berlin. An outline and description from the same paper are given herewith. The plate is composed of two half grids which are so placed against each other that each square on one grid is crossed by the edges of the square on the other grid. The active material consequently is held in a firm homogeneous mass by the cross strips of the two grids. The edges of the squares are tapered so as to hold the oxide in place. This method of construction, it is claimed, makes it possible to use in constructing plates a material which is not itself a conductor. The inventor of the Correns' accumulator therefore uses plates made of hard rubber or celluloid for street car work. In batteries with plates of such construction the weight of the material is of course considerably greater in proportion to the weight of the cell, than accumulators in which ordinary grids are used. A battery weighing 1 kilogramme with 2 volts potential, has a capacity of 25 ampere-hours, and one of 15 kilogrammes in weight will give 1 electrical horse power for an hour. Grids made for stationary batteries are formed of an alloy which is similar to that used in the Julien accumulator.



CORRENS' ACCUMULATOR PLATE.

Annual Meeting of the New England Electric Exchange.

The annual meeting of the New England Electric Exchange was held in Boston April 14. President P. H. Alexander presided and in his yearly address, traced the growth of the exchange from its inception, and alluded to the work it had accomplished. The financial success of the enterprise, he said, was assured. That the insurance underwriters entertained the idea of discontinuing inspections of electric light plants indicated how much good the exchange had done. When it began two years ago the insurance and electrical interests were antagonistic; to day the insurance companies say: "Obtain a license from the New England Electric Exchange, and we feel certain that no further inspection is needed from us." In closing, the president urged upon the members the necessity of continuing a policy of progression. Following the address of the president came the reports of the secretary and treasurer. By the former it was shown that the present membership is 93, while the latter report gave the receipts of the year as $851. expenditures, $667, and the cash on hand, $183. By the license statement it appeared there had been 354 applications for license, all of which had been granted after due examination. Officers for the ensuing year were elected as follows: President, Alexander P. Wright; secretary and treasurer, H. H. Fairbanks of Worcester; directors, E. H. Hewins, H. C. Spaulding and W. S. Hill.

A number of representatives of the New England Insurance Exchange who were present were called upon to give their views on certain questions in which both organizations had a mutual interest. The first speaker was S. E. Barton, who said that the insurance companies were disposed to abolish the custom of making inspections on their own behalf where stations were established and managed under the direction of the New England Electric Exchange, and he trusted the same conditions would obtain in all sections of the country. E. C. North said that if the insurance companies felt sure every piece of wire entering a building was properly insulated, and the work thoroughly done, the risk from fire in this connection would not be as great as that from kerosene. The great danger, however, resulted from inexperienced persons employed by sub-companies. He wanted the two exchanges—insurance and electric—to come together and labor for the benefit of both. Capt. William Brophy, electric inspector of the New England Insurance Exchange, said his duties were continually growing less onerous, owing to the Electric Exchange. There was less danger to be feared from electricity in causing fires than from any illuminant. New England was taking the lead in everything that appertained to this great industry, and marking out a way for the rest of the country to follow.

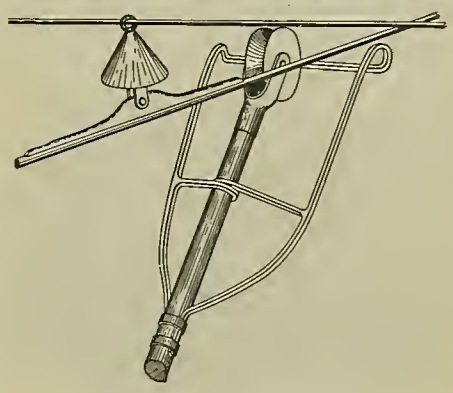


FIG. 1. TROLLEY GUARD.

Secretary H. B. Crim, of the Electric Exchange, wanted to know, providing the insurance Exchange abolished its system of inspections, where the Electric Exchange would obtain authority for enforcing its rules. He looked to the legislature if an emergency of this nature should arise.

Trolley Guard.

On those electric railways in which current is supplied to the motors from an overhead conductor through an arm extending from the top of the car, the slipping of the trolley-wheel from the wire is oftentimes a source of annoyance. When it is remembered that the lamps in the car as well as the motors, take current through the trolley-wheel, the importance of a safeguard to prevent the inconvenience resulting from such a mishap, will be appreciated.

In the accompanying cut is represented a simple device which has been designed by Prof. Elihu Thomson, of the Thomson-Houston company, to prevent these disagreeable consequences. The guard is so simple that a glance at the cut will enable the reader to understand its action. While the particular function of the guard is to prevent the trolley-pole from swinging up beyond the wire, thus breaking connection and also interfering with the cross suspension wires, the inventor makes a point of calling attention to another very important function—viz, its efficiency in maintaining the current through the lamps in the car after the wheel has left the wire. As the extinguishment of the lights is a source of annoyance and alarm to the passengers, and as such an occurrence at night oftentimes prevents the replacing of the trolley without considerable difficulty and delay, the value of this function will be understood. In addition, therefore, to the mere mechanical portion of the de-

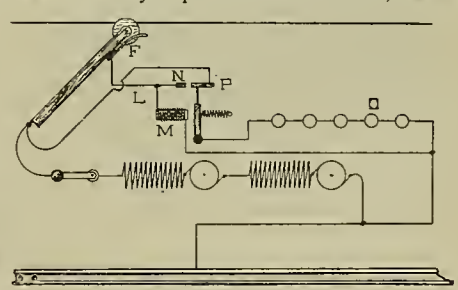


FIG. 2. TROLLEY GUARD.

vice which is shown in Fig. 1, Prof. Thomson has patented a number of methods through which the lamps may be automatically disconnected from the main trolley-conductor and connected to the guard or supplementary conductor whenever the circuit of the former is interrupted by reason of the trolley getting off from the main conductor. One of these methods is represented diagrammatically in Fig. 2. In this the guard F is provided with a supplementary conductor L, leading down to the magnet M, and thence to the opposite side of the circuit. The magnet M is of considerable resistance and will become energized when the guard comes

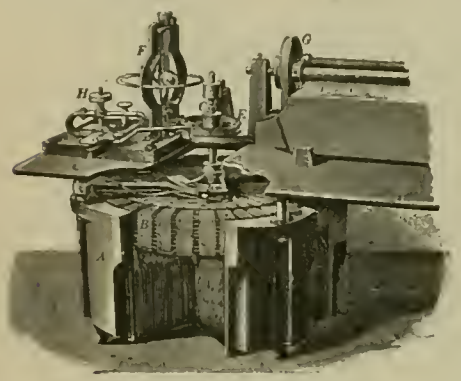


FIG. 1. PHONOGRAPH MOTOR.

into contact with the main conductor. When this occurs the armature of the magnet will be attracted, and the normal circuit through the lamps O and by the armature to contact-point P and the main trolley-conductor, will be interrupted and a new circuit established from the lamps O by the armature to contact-points N, to the wires L, to the guard, and the conductor. By this arrangement the lamps O will be in circuit whenever the guard comes against the main conductor.

The Phonograph Motor.

It will be remembered that Mr. Edison, while engaged in the work of improving the phonograph early realized the necessity of having a motor that would maintain a perfectly constant speed. He experimented with a number of different types, and finally adopted the form of machine illustrated in the accompanying cuts.

In Fig. 1 the motor is shown removed from the case and with a portion of its supporting plate broken away to expose the commutator. As may be readily seen, the field magnet, A, is formed with four polar extremities, and the armature consists of a ring, B, of the Pacinotti type, with a laminated core. The field magnet extremities are alternately of north and south polarity. The armature shaft is journaled at the

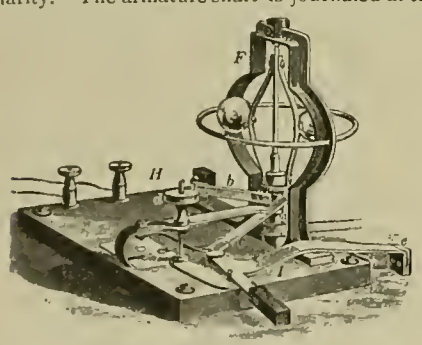


FIG. 2. PHONOGRAPH MOTOR.

bottom in a step formed in the yoke of the field magnet, and at the top on a point, C, supported by an arm projecting upward from the base plate of the instrument. It is provided with a pulley, E, which drives the governor, F, and with a small pulley arranged below the pulley, E, and connected with the pulley, G, on the horizontal phonograph shaft by means of a belt whose direction is changed by two guide pulleys. The ring and the commutator are divided into 24 sections, the connections of which are arranged to produce four poles in the armature. The commutator brushes are held 90° apart by a curved vulcanite bar, D, supported by an adjustable arm. The motor is shunt-wound, and adapted to a 2-ampere current having a pressure of 2 volts. It may be operated by a primary or secondary battery; the latter is preferred for use in places affording facilities for recharging, although the primary battery furnished with the instrument is easily mounted, and yields sufficient current for about 30 hours' use with one charge. In Fig. 2 the governor is represented. This is remarkable both for its simplicity and the accuracy with which it controls the speed of the motor. On the wooden base is mounted the vertical frame of the governor, in which is journaled a spindle, having near its lower extremity a pulley for receiving the belt from the pulley, E, on the motor shaft. To the upper part, and on opposite sides of the spindle, are secured two springs which extend downward. Their lower ends are secured to the flanged sleeve, a. To the iron frame of the governor is secured a brush, b, which bears continually on the sleeve, a. The regulating device, H, consists of a curved spring supporting the brush, c. Above this brush is arranged a spring arm which is made to bear upon and change the position of the brush, c, by turning the milled nut, d.

When the flange on the sleeve, a, touches the brush, c, the entire current of the battery flows unimpeded through the motor, but when the speed of the governor increases in the slightest degree, the balls are thrown outward by centrifugal force; thus bowing the springs outwardly and lifting the flanged sleeve, a, from the brush, c, causing the current to flow through a small resistance arranged underneath the base of the governor, thus diminishing the current, consequently preventing any increase of speed in the motor. Usually this sensitive governor keeps up an incessant shifting of the current, giving the armature a succession of little impulses whose effect is to maintain an almost absolutely constant rotation phonograph cylinder.

Chicago's Electrical Department.

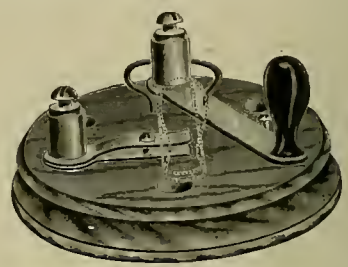
Mayor Cregier, in his annual message to the Chicago city council, gave considerable attention to the electrical department. The following abstract contains his comments and suggestions:

"The fire alarm or electric department of the city is a bureau of the fire department. This branch of the service, always important and conspicuous for its efficiency, is becoming more so as electric science advances. The work of constructing and operating the public electric lights is assigned to this bureau. Three hundred poles and about 60 miles of alarm-wires have been added to the annexed districts during the year. The city now owns and operates three independent light plants, two of which were constructed and put in operation during the last year. A fourth plant is about ready to start. Within these four districts there are sufficient conduits and cables in place to serve 1,000 lamps. At present, however, there are only 550 in use, but this number is being constantly increased. The city is divided into twelve districts. District No. 1 is fully equipped with conduits, etc., at a cost of about $30,000. The lights would have been put in operation several months ago, but the city was enjoined from erecting the necessary power house in the rear of the Exposition building, and as there were no funds for purchase of ground elsewhere the work done in district No. 1 is idle. This branch of the work will be utilized at an early day by locating the power house on the city's property at Fourteenth street.

"The total expenditures for public electric lights is about $429,500; about one-third of this amount, for subway works, is not yet in use. The 550 electric lights now in operation have displaced 1,541 gas lamps costing for gas $20 per annum, making a gross reduction in cost of gas of nearly $31,000. The subject of general use of electric lights, not only for the streets of our city, but also for dwellings and other private uses, is alike interesting and important, and invites the consideration of our city authorities. The ratio of cost per light decreases in proportion as the number is increased by the power of any one plant up to its maximum capacity. The city electrician states in his report that from 16 to 20 candle power gas costs the city from $18 to $20 per annum, or at the rate of about $1 per candle power per annum. Under the present unfavorable economic conditions 2,000-candle power electric lights cost $80 per annum, or at the rate of 4 cents per candle power per annum. While this statement discloses an enormous difference in cost per candle power, to say nothing of the advantages of electric light over gas for illuminating public highways, under the present unfavorable conditions the actual cost of electric light is about the same as gas. This is based on the fact that where one electric light at a cost of $80 per annum is in operation it displaces four gas lamps at $20 each. In my judgment the municipality should own, control, and operate all works that produce that which is indispensable to its own and the general public necessities and which could be furnished at little or nothing above cost. Chicago supplies her citizens with water. She provides channels of drainage. It is equally proper that the city should furnish her citizens with light for household purposes as well as public use. Nor should we stop here. To furnish heat, power, and intramural transportation are not only within the scope of legitimate legislation, but the practical establishment and operation of such under municipal control would meet a great public want, be a lasting benefit, and prove a source of economy and convenience to the entire community. It is to be regretted that our city can not—owing to a lack of funds—give any consideration to matters of the kind at present, but I am persuaded that improvements in the line referred to are within the range of probabilities in the near future. Upon the subject of electric light, however, I feel that in addition to street lighting the citizens should enjoy the privilege of the service suitably adapted for private use. This could be met by the comparatively small additional expense of increasing the engine and dynamo power at each plant, and a consequent proportionate increased consumption of fuel. The same buildings and corps of attendants that are now required to furnish 100 lights could perform the work necessary for 2,000 or more lights. I am informed that whenever a sufficient number of lights are to be generated at one plant they will cost less than gas, and in time public lighting may, like our waterworks, become a boon to our citizens, be self-sustaining, besides bringing a handsome revenue to the city."

McLennan Single Contact Switch.

In the accompanying cut is shown the McLennon switch, manufactured by the Knapp



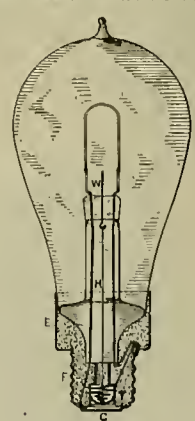
M'LENNAN SINGLE CONTACT SWITCH.

Electrical Works of Chicago. This device has proven thoroughly efficient where a single contact is desired, and where this alone is required, it has taken the place of more elaborate switches. As represented in the cut the switch is opened, the arm being held by the spring at the back. When it is desired to close the switch the arm is forced to the left, between the two straps of brass, which afford ample contact surface. The position of the arm when the switch is closed is indicated by the dotted lines. K. McLennan, of Chicago, is the inventor of this device.

Cut-Out for Series Incandescent Lamps

The accompanying illustration represents a new cut-out for series incandescent lamps, which has just been patented by Mr. Edison. The main object of the invention is to construct and arrange the parts of a cut-out, so that all the mechanism will be entirely contained in the lamp itself. In other words, so that the metal parts of the socket will not be required to form part of the cut-out apparatus.

Upon the lower end of the lamp is secured a plaster-of-paris base. This holds a metal band



CUT-OUT FOR SERIES INCANDESCENT LAMPS.

E, the screw-threaded collar F on the outside of the base, and in a recess formed in the bottom of the base, the metal thimble T. The base is formed, as is well understood, by pouring the plaster into a mould around the lamp-neck. This holds in place the two rings and the small thimble T. At the bottom, and covering but not touching the thimble T, is the cap C. The electrical connections, disregarding the cut-out mechanism, are as follows: Current enters at cap C, passes up through the filament, and thence to the other terminal F of the lamp. The band E has no electrical connection with

the circuit. The arrangement of the cut-out will now be readily understood. Referring to the illustration it will be seen that in the glass between the lamp wires there is sealed a piece of platinum wire *W*. This extends up between the terminals of the lamp filament, and has its lower end formed into a hook, as shown. Attached to this hook is a fine fusible iron wire, *H*, which extends down, and is soldered to a small button sliding in the thimble *T*. Between the button and the bottom of the thimble is a small spiral spring. The fusible wire passes

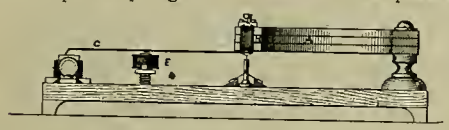


FIG. 2. DELANY'S RECEIVING APPARATUS FOR CABLE TELEGRAPHY.

through this, as indicated, and is attached to the button so as to keep the spring under compression. The action of the cut-out will now be understood: The lamp being placed in series with a number of others, if the filament breaks, an arc usually forms across the vacuum between the filament terminals. When this occurs, the platinum wire *W* and the fine iron wire *H*, which is connected with the circuit outside the lamp, receive so much current that wire *H* is fused. This releases the spring, and the button is forced down against the terminal *G* and connects it with thimble *T*. This action completes a shunt around the broken filament.

Electrical Data for the Census.

Allen R. Foote announces that the work of compiling the statistics concerning the electrical industry for the next official census is progressing rapidly. He says the following schedules have been completed: Manufacturers of electrical apparatus, instruments and supplies; electric light and power central stations; fires caused by electric currents; fatal casualties occurring on electric circuits, fires caused by electric currents; special investigation in cities of 10,000 population and over; fatal casualties occurring on electric circuits; special investigation in cities of 10,000 population and over; isolated electric lighting and power plants, educational institutions, electrical engineering courses.

Manufacturers of electrical apparatus have been solicited to furnish information for a chapter on the articles which they are making, and mention is desired of any novel features of special uses to which the apparatus will be put.

Delany's Receiving Apparatus for Cable Telegraphy.

The invention illustrated in the accompanying cuts is intended to be used on lines or cables where the Thomson or siphon recorder is now employed. Its purpose is to insure a distinct reception of the delicate signals by means of ordinary telegraph instruments. That is, by such apparatus as is now employed on land lines.

This receiver was specially designed to operate with a system of cable transmission, previously

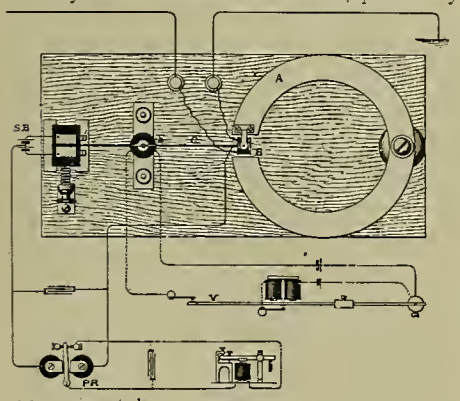


FIG. 1. DELANY'S RECEIVING APPARATUS FOR CABLE TELEGRAPHY.

invented by Mr. Delany. The system referred to provides for the transmission of impulses of equal duration and alternate polarity, and also for the use of regularly alternating, neutralizing, or clearing impulses after the signal impulses to neutralize the static discharge of the cable. The arrangement permits of rapid signaling and a uniformity of movement of the receiver, which, it is claimed, is not obtainable by any other system. Figs. 1 and 2 are respectively a plan view with connections represented diagrammatically, and a side view of the instrument alone. Referring to the cuts, *A* is a permanent magnet and *B* is an oscillating coil such as is ordinarily used in a Thomson recorder. Attached to the coil is a light arm or finger *C*, made of aluminium. The end of the finger is bent so that its platinum point will strike on one of two insulated metallic contact plates, *D* and *D'*. Between the point of the finger and the coil *B* there is arranged as shown an electro-magnet *E*. The circuit of this magnet is interrupted by an automatic vibrator *V* whose rate and amplitude of vibration may be changed by shifting a small weight on the arm.

Directly over the magnet *E*, and attached to the finger *C*, is a small iron piece or armature. This is attracted by the electro-magnet at each closing of its circuit, and by this means the light finger *C* is kept in continuous vibration at right angles to its plane of oscillation. The object of keeping the arm in constant vibration is to relieve it of friction against the contact plates *D* and *D'*. The normal position of the finger-point is on the insulation between the contacts *D* and *D'*. The local "split" battery *S B*, the polarized relay *P R*, and an ordinary sounder are connected with the instrument as indicated.

The operation of the receiver is as follows: When no current is on the line, the finger *C* vibrates on the neutral space between contacts *D* and *D'*; the lever of the polarized relay in circuit with finger *C* will be against its stop; and the sounder circuit will be open.

If now the distant transmitting operator closes his key, a current of positive polarity will be sent into the cable, the impulse being automatically terminated as soon as the key reaches its down limit. The effect of this impulse at the receiving station is to cause the suspended coil *B*, which is connected in the line, to turn upon its axis—say to the right. The point of the vibrating finger now leaves the neutral space and vibrates on the segment *D'*, completing the local circuit of the polarized relay, reversing the position of its armature, and closing the sounder circuit. If the sending operator is transmitting a dot, he raises his key promptly in the ordinary manner, and a negative current of the same duration as the preceding positive current, is sent into the cable. The effect of this negative impulse at the receiver is to cause the coil and vibrating finger to swing quickly to the left-hand segment *D*. This reverses the polarized relay, and opens the sounder circuit, thus denoting a dot on the sounder. If the transmitter's key be left up, the vibrating finger assumes the neutral position, and the tongue of the polarized relay remains where last placed, and sounder circuit is open.

If an operator desires to send a dash, he simply holds down his key, as usual. While the transmitted impulse is of no longer duration than that used for the dot the vibrating finger returns to the neutral position slowly, owing to the "failing" or gradual diminution of the current in the cable. In this manner dots and dashes may be received in the usual way by means of an ordinary sounder.

Renard Battery.

The accompanying cuts represent a battery which was designed originally by M. Renard for the propulsion of his balloon, La France. The several cells which are grouped as shown, are composed either of a cylinder of carbon or of a plate of platinized silver for the positive pole and a pencil of zinc for the negative pole. The zinc is not amalgamated. The depolarizing agent is composed of chromic acid, hydochloric acid and sulphuric acid mixed in certain proportions in accordance with the character of work which is to be done.

Renard designed the battery in order to secure lightness. It is now made in two forms, one of which, Fig. 1, is intended to furnish current for light, but not, it may be said, economically. The zinc *C* and carbon elements *B* are placed in a glass or porcelain tube-like vessel, *A*, which is sealed to the cover of the air tight containing jar. At the lower end of the tube is a hole *O*. The battery represented in the cut is composed of seven cells. When air is forced into the jar by means of the bulb, *p*, the depolarizing liquid rises in the several cells. There is a stop cock at *b*, so that the height of the liquid, and as a consequence, the internal resistance and the amount of current, can be controlled.

Fig. 2 shows the form of the batteries in which lightness is the only desideratum. Twelve cells are grouped in the mounting frame *B*. The positive plate, which is of platinized silver, is rolled into the form of a tube *C*. The use of the platinized silver reduces the weight, volume

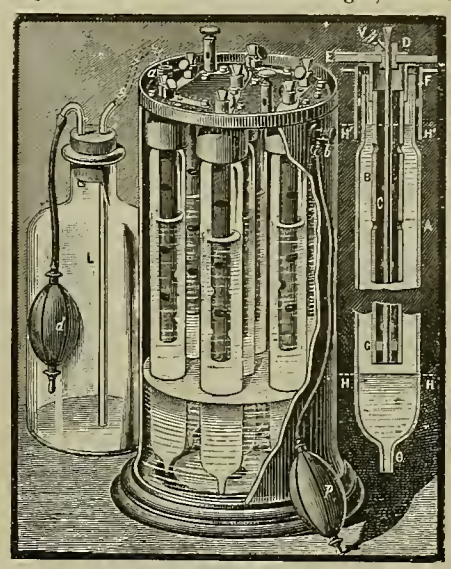


FIG. 1. RENARD BATTERY.

and internal resistance in a considerable degree. The thin, unamalgated zinc electrode is shown at *D*. The weight of the battery is 26.8 pounds, and its capacity 220 watts.

Tests which have been made of the battery, demonstrate, it is claimed, that it is the lightest generator of electricity known. Although the cost of such batteries is high, they can be employed to advantage in a limited way in certain cases where lightness is an indispensable element, as in aerial navigation. M. Renard states that electricity cannot yet solve the problem of aerial navigation. To obtain a speed of ten meters a second for an hour with a balloon such as La France, it would be necessary to carry 2,680 pounds of the Renard battery. This as he says, is sufficient in itself to show that the use of the battery is not practicable. However, he remarks that we must not lose sight of the fact that the batteries are extremely useful in making it possible to conduct certain tests for the measurement of resistance to aerial crafts.

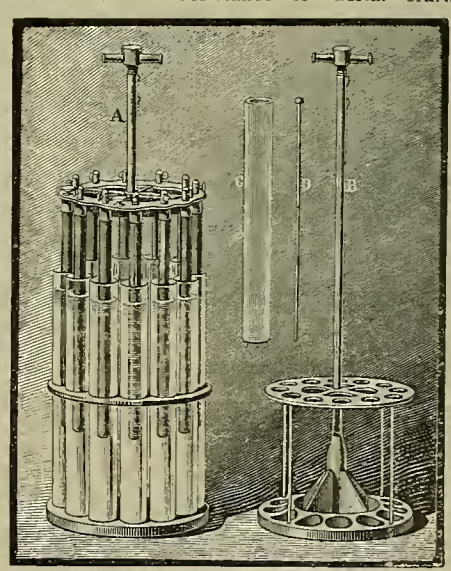


FIG. 2. RENARD BATTERY.

Such tests, he says, prove conclusively that the problem of controlling and propelling balloons, though not solved, is not one that is altogether Utopian. The cuts are reproduced from *La Nature*. M. Renard has just been granted an American patent on his battery. Two claims are allowed—the first relating to a galvanic cell, consisting of a cup containing chloro-chromic acid and silver electrodes, platinized on both surfaces, and the second, relating to a single fluid cell, having an exciting liquid composed of chromic acid and hydrochloric acid combined with sulphuric acid.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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MAYOR CREGIER'S recommendations to the Chicago city council in his annual message contained several interesting allusions to the electrical department which, under the able administration of Prof. Barrett, has become one of the most efficient branches of the city's government. That portion of Mayor Cregier's message referring to this department is reproduced elsewhere in this issue, and is worthy of careful perusal.

MAYOR GRANT of New York is reported as saying that "nothing can convince" him that the electric light companies of the metropolis have not formed a combination and the gas commission has refused to make contracts with the electric companies for the ensuing year. The companies have offered to refer the matter to any impartial electrical engineer, and if the municipal authorities refuse this proposition they alone will be responsible for the condition of the streets. At present there are but 871 electric lights in the streets of New York.

HENRY VILLARD'S movements in the Northwest have been the subject of much newspaper speculation during the last year. It was announced that he had invested largely in enterprises in Minneapolis and St. Paul, and would expend large sums of money in developing the electrical interests in those cities. All of these statements were confirmed by Mr. Villard in his public speeches at the banquets given in his honor in the Twin cities. He explained, however, that his experts had not confirmed the representations that had been made to him in regard to the amount of water power available at Meeker's Island in the Mississippi river. As stated in the WESTERN ELECTRICIAN last week he would be obliged to abandon this scheme, therefore, for the present at least, but he assured the business men of both cities that he was deeply interested in their progress. In another column is presented a report of Mr. Villard's speech in which he unfolded his electrical plans.

IT is feared that the labor troubles in Chicago will seriously affect electrical interests unless the contractors and workmen reach an understanding soon. The carpenters went on a strike first and 6,000 members of their labor organization paraded the streets of Chicago last week. The fact that these men have quit work will of course greatly retard other branches of industry. The bricklayers and stone masons also threaten to strike May 1st unless their demands for advances are granted. All of this of course will operate against the progress of electrical work. It is to be hoped that a speedy solution of the trouble may be reached.

HENRY B. STONE, who is to be president of the Chicago and Central Union Telephone companies, is well-known throughout the land as one of the ablest railroad managers in the country. It was through his efforts and under his personal direction that the great Burlington system was practically rebuilt. It had passed through a terrible ordeal, a protracted strike which involved the loss of nearly four millions of dollars, and diverted trade into other channels, and to Mr. Stone was intrusted the work of placing the system once more on a sound financial basis. This he has already accomplished, for not only is the debt wiped out and the era of dividends returned, but the business of the company is much better than at any previous time.

IN another column is presented an interview with an officer of the General Electric company of Berlin. He speaks with considerable enthusiasm of the bright prospects of electric lighting in that city. It will be noticed that the plan of distribution which has been adopted involves the use of accumulators on a large scale. Tests which have been made of the storage battery which is to be used, warrants the company, says Herr Rathenau, in believing that its system will be successful. He thoroughly believes that the solution of distributing electricity in cities is to be found, not in the employment of high potentials, but in using low pressure with many accumulator sub-stations. The installation will be most extensive on which accumulators have been used, and the progress of the company's work, therefore, will be watched with interest.

THE Pan-American congress has adjourned. It has recommended much, but has done little, and its recommendations if adopted, cannot be put into effect at an early day. Legislative action is necessary on all of these recommendations, and this, it is thought, cannot be secured in less than two years. For instance the Chilian congress sits during June, July and August, and as the Chilian representatives will not reach home until the latter part of August it cannot be expected that anything will be done until the following year. The same is true in other countries. One of the most important measures proposed was the improvement of communication by telegraph and cable between this country and the republics of Central and South America. This topic, while of great interest to all industries in any way connected with South American trade, is of special importance to the electrical fraternity, as it may involve the construction of additional cable and telegraph lines.

It is hardly to be expected that the proposed measures will be accepted by the several countries without many changes and, however unimportant they may be, they will entail additional diplomatic negotiations, all of which requires much time, consideration and discussion. In the meantime, however, the visit of the delegates to this country must have a good effect. The visitors have had their eyes opened to the advances that have been made in the United States and the people of this country have been impressed by the fact that there is in Central and South America a fine market for the products of their skill and genius. Representatives of electrical industries are alive to this fact, and the development of this new field may be confidently expected.

IT will be remembered that a legislative committee in New York recently was instructed to conduct an investigation of the several systems of electric lighting employed in the Empire state, with a view of recommending rules for the restriction or regulation of the industry. This committee devoted considerable time to the investigation, it is stated, but accomplished nothing; in fact, in its report to the senate it says it found the subject was one that required technical knowledge, which the members did not possess, and it frankly acknowledged that it "did not think it possible for the legislature to form satisfactory rules and regulations for application to an industry that is not only highly technical, but constantly developing and presenting new conditions, rendering the rules proper this year, possibly obsolete next year." This was a frank admission, and as such commended itself to all who were fully acquainted with the difficulties which must be encountered in an attempt to regulate the electrical industries. Despite this admission, however, the committee has decided to continue its so-called "investigation," and is now in session in New York considering the question of electric street railroads. It is expected at the conclusion of this inquiry—it is to be hoped it will end somewhere—another report will be made to the senate in the same line as the first. Why then, continue these fruitless investigations which merely entail a waste of public funds without apparently serving any good purpose?

WE regret to say that the rumors which have been in circulation concerning the failure of a portion of Ferranti's high-tension underground system in London appear now to be substantiated. In his report to the London Electric Supply corporation, Limited, Mr. Ferranti frankly admits that some of the mains have proved to be utter failures, and as a result, he says, the company is not at present in a position to operate more than one-quarter of the station's capacity. Another set of conductors which Mr. Ferranti states has been most carefully and severely tested, is shortly to be laid, and then he expects to supply current to the full capacity of the Deptford plant.

In an editorial in reference to the affairs of the Deptford company, the London *Electrical Review* rather throws cold water, so to speak, upon what it designates as the "10,000 volt scheme." While our contemporary may be in a position to watch the progress of the Ferranti system, we are still inclined to the view that it lacks the humble virtue of patience. American electricians who know just how great and numerous are the troubles encountered in underground work, would hesitate to say that currents at 10,000 volts' pressure could not be successfully distributed. Time and again, on this side of the water, it has been abundantly proved that persistence has wrought wonders in the electrical field, and especially in underground work. Americans will not find in the failure of a few Ferranti cables any cause for discouragement; they will rather regard the failure as something perfectly natural in the execution of a new enterprise. It must be remembered that Mr. Ferranti is in one sense a pioneer, and hence is without the experience of others to guide him. He has undertaken to distribute alternating currents at a pressure far in excess of anything yet attempted. It is to be expected, therefore, that he will find in his path many difficulties, big and little. He is thoroughly in earnest and apparently determined to overcome these obstacles. All high-tension workers in this country admire his pluck, and trust that he will find a speedy solution of all the vexatious problems that present themselves.

Hauberg Dynamo.

A view of the Hauberg dynamo, which is made at Copenhagen, is given in the accompanying cut. The machine is shunt wound, and has a capacity of 500 amperes at 112 volts, with a speed of 500 revolutions per minute. The maker states that the weight of copper in the armature is about 260 pounds, and that of the shunt winding 282 pounds. A high efficiency is claimed for the machine, the manufacturer stating that only 4 per cent. of the energy developed is lost in heat. The field magnet is easily wound, as the length of the bobbin is the same as the width of the space between the pole pieces. On account of this construction the magnetic circuit is interrupted only by the air space which separates the poles of the magnet from the body of the armature. In this machine the magnetic circuit is almost circular. The curve of the magnet, which is, as indicated, quite small, consequently the magnetic resistance is low. In spite of the weight of the field magnet, therefore, there is only a small amount of copper used. The cut is reproduced from *L'Electricite.*

Chicago Electric Club.

The third annual meeting of the Chicago Electric club was held Thursday evening, April 17th. It was the first annual meeting held in the new club rooms, and the members showed their interest by attending in large numbers. The polls were open during the evening and 112 votes were cast. When President Beach called the meeting to order he presented his annual report summarizing the events of the year, as follows:

"In this, the third annual report of your president covering the year closed to-night, it has been thought best to incorporate as one document the reports of the treasurer, secretary and board of managers. It has been thought that this method will make the report more concise and trespass less upon your time, besides being better adapted for future reference."

The treasurer's report, which was here read in detail showed the financial department to be ably administered. The receipts for the year were $10,707.48, the expenditures $10,553.78 leaving a balance of $153.70. The assets of the club amount to $2,750, without reference to the expenditure of $1 200 on the rooms. The club is now on a paying basis.

"I am able to report a very handsome increase in membership during the past twelve months. On the first of April, a year ago, the club had a resident membership of 101, and a non-resident membership of 34. The membership to-day is: Resident 173, non-resident 57, showing a net gain of 72 resident members and 23 non-resident members or about 70 per cent. It is the present practice of the management to promptly strike from the list the names of members in arrears after giving them a reasonable time for making payment, so that the above figures represent a solid paying membership. There never was a time in the history of the club when applications for membership were coming in faster than at present, and I believe the prediction may therefore safely be made that the coming year will see a further substantial increase in the membership.

"The list of papers read during the past year is a most excellent one. It might be cited in this connection that the Chicago Electric club is the only electrical literary society in the country, of which I am aware, giving its members two papers a month with the resulting discussions which are in themselves of great additional advantage. High-class journals both in this country and abroad continue to make liberal abstracts from the proceedings of this club, frequently publishing the papers in full. The club has been particularly fortunate in having presented before its membership timely papers bearing directly upon the subjects most interesting to the electrical fraternity at the time. This has added to the value of the papers, and I think the club is to be congratulated in consequence.

"The nucleus of a library has been formed during the year just closed. As you are aware, the American Electrical society has turned over to the Chicago Electric club the very valuable collection of books which can soon be seen in a suitable case in the reading room. This collection of books is a very valuable one containing some particularly rare volumes. It is impossible to overestimate the extent to which this club is indebted to the American Electrical society for its courtesy and kindness in this instance, and appropriate resolutions of thanks have already been passed by the board of managers and transmitted to the officials of that society. To this library will be added as fast as practicable, the best electrical publications, and indications are that in the near future the club will have a very complete and interesting library covering whatever is best in electrical literature.

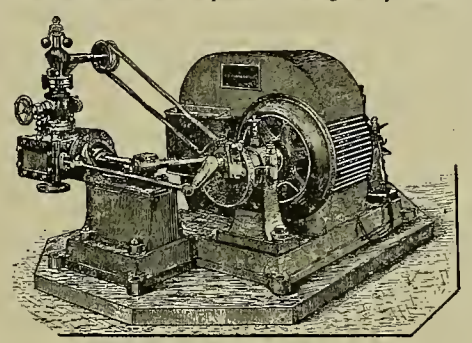
"As most of the members are doubtless aware, the lease of our present club rooms does not expire until May 1, 1891. We shall therefore continue to occupy our present quarters until that time at least.

"It is with deep regret that I have to announce the death of two of the club's most esteemed members during the past year: Mr. King, of Jacksonville, Ill. and Mr. Glasier, of Chicago. Appropriate resolutions were passed in reference to the late Mr. King and transmitted to his widow from whom the club received an appreciative letter of thanks. The decease of the late Mr, Glasier is of more recent occurrence, and the chairman of the special committee appointed by the board of managers to represent the club in connection with the funeral arrangements now in progress, will report to you direct.

"It is the policy of the management to strive constantly for a higher standard of literary work and the efforts of the management in this direction should be cheerfully seconded by each and every member of the organization. As regards the social opportunities afforded by the club, it is believed that membership in this society is conducive in no small degree to important advantages in this direction, and the daily intercourse and exchange of ideas among the members of this club, cannot fail to conduce to rapid developments in the electrical field. No other conclusion is possible when it is remembered that the club numbers among its membership some of the most able and distinguished electricians in this country. From present indications it is evident that this club will receive during the coming year a strong representation from certain departments of the electrical industry which are at present but moderately represented on its membership list. I desire to call attention to the fact that the duties of the membership committee are becoming more and more important as the club progresses, and the most careful scrutiny is being given and will be given in the future, to all applications for membership. This amounts to a positive assurance as regards the character of all members admitted to the club, a thing which is of the most vital importance.

"There have been during the past year several very pleasant entertainments given in the club rooms, some of them of quite an elaborate character. On two occasions it has been the good fortune of the club to be able to extend to representatives of the electrical industry from other sections of the country, courtesies which those receiving them have taken pains to assure us were highly appreciated.

"I desire to bring to the full appreciation of the membership the fact that this club, maintaining no cuisine of its own, and being to no risk or expense in this direction, is able under the arrangements now existing to give its members a restaurant service equal if not superior to any club in the city of Chicago, This is an important feature, and one which should receive the full appreciation and support of the members. This arrangement has been existing since the club secured the present building, and you are to



HAUBERG DYNAMO.

be congratulated on the facilities which exist. This feature could, however, be developed and made much more valuable to the club and its members perhaps, and it is suggested that all members co-operate with the management in this direction by giving to the restaurant as much of their patronage as may be done consistently. The service is now believed to be as prompt as is the case with most clubs, and with double the patronage which it now receives, considerable improvement could be made in this direction.

"In conclusion, I desire to add my hearty congratulations to the other members of the club upon the gratifying growth in the number and character of our membership during the past year, and I feel assured that our constant adherence to the principles and purposes upon which this club is based, is destined to make it in the near future one of the strongest and most influential social and scientific associations in the West, and I feel that it cannot be too strongly urged upon each individual member, that our efforts and attention be not relaxed in this direction. I also desire to take this opportunity to express my sincere thanks to the officers and board of managers of this club for their hearty co-operation and support during the period which it has been my good fortune to act as your president. My term of office having extended but a few months I feel it my duty to remind you that a large part of the growth and progress achieved during the past year is due to the untiring efforts and liberal policy inaugurated and carried out by my predecessor, S. A. Barton, who occupied the presidential chair of this club during a large portion of the year covered by this report."

The reading of the report received marked attention, and at its close the president was heartily applauded. A vote of thanks was extended the retiring officers for the care and fidelity which had marked their work during the year. The president's report was ordered printed.

Alexander Kempt, chairman of the committee appointed by the board of managers to make arrangements for the funeral of the late H. A. Glasier, submitted his report which was accepted, and on his suggestion a committee was appointed to prepare suitable resolutions. It was composed of the following named members: Messrs. Kempt, Kreidler, Degenhardt, DeLand and Cone. A number of the members took occasion to refer to the excellent character of the late Mr. Glasier and the admirable qualities which had endeared him to every member of the club.

F. S. Terry and F. E. Degenhardt who had been appointed tellers for the annual election, reported that 112 votes had been cast, and the following named gentlemen had been elected: President, F. G. Beach; vice-presidents, F. B. Badt, Alex. Kempt, D. P. Perry and W. H. McKinlock; secretary, W. A. Kreidler; treasurer, F. S. Terry; board of managers, B. E. Sunny, M. A. Knapp, F. W. Cushing, George O. Fairbanks, William Taylor, F. E. Degenhardt, E. Baggot, F. W. Parker, George C. Bailey, C. H. Wilmerding; membership committee, C. C. Haskins, George Cutter, W. B. Pearson.

Henry Villard's Plans for Minneapolis and St. Paul.

Henry Villard was banqueted at the Hotel Ryan, St. Paul, on his recent visit to that city, and the enterprising business men of the Twin cities assembled to learn what he intended to do toward developing the natural advantages of their cities. In the course of his address he said:

"Now, it is probably not known to many of you, but I have had something to do with the practical application of electricity to the creation of power for the last eleven years. My activity in that respect has not been so noisy as my railroad activity, but it has been unceasing; in other words, I have been identified with Mr. Edison, the inventor, ever since he discovered the feasibility of electric light in 1879. I have been honored with his friendship and have been one of his active supporters and financial backers. The development of electricity as a creator of light and power was not as rapid during the first five years after Mr. Edison made his primary discovery as it has been during the past few years, and I have been lately impressed with the conviction that there would be an enormous development shortly in connection with the practical uses of electricity for power, and I set about some two years ago to effect a consolidation of the various companies manufacturing lamps, dynamos, motors and other electric materials. I succeeded in consolidating these companies, and I succeeded further in raising a large foreign capital for the consolidated company. That company is known as the General Edison Electric company. It has a capital of $30,000,000, of which $5,000,000 have already been paid in. It was through connection with that company that I was led to consider the two cities as a field of profitable exploitation in the matter of electric light and power. My attention was called to the possibility that a large and cheap power might be obtained by utilizing the waterfall between Minneapolis and St. Paul, so far as it was not used by existing milling and other concerns in Minneapolis. I employed a competent expert to ascertain the possibilities in connection with this dormant natural resource. That investigation, I am frank to say, did not produce as satisfactory results as I was justified in expecting from the statements that had been made to me as to the state of existing unemployed water power, and as to the available means of controlling that water. A conclusion was reached by my experts, in the first place, that there was not as much power as was stated—you remember it was said that there was a maximum of 25,000-horse power—our findings showed that there was hardly more than between 6,000 and 7,000. A leading difficulty was also found in the fact that the power was claimed by at least three different companies; and the cost of utilizing it would be much larger than had been anticipated. Altogether, the outlook was not as encouraging as I was originally led to expect.

"But, nevertheless, I can say to-night that a systematic effort will be made by me to create and produce a liberal, large supply of cheap power for these two cities in connection with the development of electric light and power for traction and manufacturing purposes; notwithstanding that there is not sufficient encouragement, or does not seem to be sufficient encouragement, in the proposed development of the water power of the Mississippi river. I mean to say that, to make myself more clearly understood, I have a controlling interest in the existing Edison company here; I have also acquired a controlling interest in the St. Paul Gas Light company; not with a view of creating a monopoly, but on the contrary, with a view of furnishing the people of this city the best light of both kinds and the cheapest light that is furnished in any city of the United States situated as this is with reference to the supply of fuel. As I said, notwithstanding the fact that we have been somewhat disappointed in our expectations of the possibility of procuring cheap power from the rapids of the Mississippi, we shall go on and produce the power necessary to promote manufacturing interests, to furnish electric light, and furnish power for traction purposes—we shall carry out our programme in these respects to the fullest extent.

"We propose to erect a large central power station in this city, from which electric lighting shall be done, from which power shall be furnished to such of the manufacturing industries here as may need it at a rate so cheap that it will be more desirable than steam, and moreover, we propose to furnish our friend Mr. Lowry, if he be willing, the power for carrying his electric cars. As you of course all know, Mr. Lowry is engaged in changing his present horse car system into an electric system. I am confident that the proposed enterprise will furnish all you people of St. Paul need to attract manufacturing industries here. It is in our programme to provide Minneapolis also with a central power station, and to give to the people of both cities the basis upon which to build up manufacturing industries that so far do not exist among you, and the condition of whose development is, in the main, cheap power."

Another reception and banquet was given at the West Hotel, Minneapolis, where Mr. Villard was again called upon to refer to his plans. After reviewing briefly the same subjects referred to in his St. Paul address, he said:

"As many of you know, there was a striking exhibition of what has been accomplished in the use of electricity shown at the Paris exposition, known as the Edison exhibit. But although it bore his name it was really the work of the

Sprague Electric company, of which I am the president. That same exhibit is now on exhibition for the benefit of one of the charities in New York City, and besides a great deal more arranged since the exhibition, it comprises a most wonderful display of incandescent lighting, the most extraordinary display that has ever been made anywhere. It also includes the greatest display of Edison's phonographs and long distance telephones which exists. Now as president of this company I place this exhibit at your disposal for your coming exposition, and I hope you will find sufficient space for it. I am sure it will be both instructive and entertaining. I will be very glad to confer with whomever has charge of your exposition here."

Electrical Engineering at Columbia College.

The new building which was erected for the accommodation of the Electrical School of Columbia College, New York, has now been fitted up specially for the purpose, and contains a number of interesting features.

The facilities for obtaining electric current of different kinds, and in large quantities, are particularly satisfactory. Continuous current to the amount of 100 amperes under pressure of either 110 or 220 volts may be had at numerous points in all the rooms from a specially installed circuit of the 3 wire system connected with the Edison Thirty-ninth street station. Available at adjacent points and parallel to this circuit is another special circuit of equal capacity on the two-wire system, coming from the Edison dynamos of 400 lights' total capacity in the cellar. A third special circuit also of 100 amperes' capacity has been put in to connect dynamos, motors, etc., in the electrical workshop with measuring instruments in the upper laboratory which is devoted to delicate work. A storage battery circuit available at convenient points in the various rooms is to supply current under an e. m. f. of a few volts for testing purposes, galvanometer work, electrolysis and the many other duties which are generally performed in the laboratory by a number of separate primary batteries with their attendant inconveniences. The buildings are lighted entirely by electricity from the regular circuits. Gas for heating and other purposes may be had wherever needed from pipes fitted around the walls of each room just below the ceiling.

The connection with the Edison central station is of great convenience, as current can be obtained and experiments carried on continuously without regard to the usual noon and evening stopping of machinery, which is such a source of annoyance in this work. In one particular case a current was used with absolutely no interruption night and day for almost a week. The connection with the Manhattan company's alternating circuit has lately been cut off by the city authorities, but alternating current and arc light dynamos are soon to be put in, in order to avoid this unpleasant contingency. To avoid as much as possible any jarring, the tables for the support of instruments have no connection with the floor, but are fastened directly to the brick walls.

The course of instruction is divided into branches—the practical and the theoretical. The study of mathematical physics and the theory of electricity has been introduced as a necessary part.

The first session of the first year in the practical course is given up to the study of the fundamental principles of electricity, which deserve more attention than they generally receive. In the theoretical branches of the subject are studied the theory of electric potential, electro-static distribution and induction, theory of the condenser, dielectric polarization, etc. The theory of electrical measurements starts with the principles of the conservation of energy, Joule's law, etc., and then passes to the construction, performance and use of electrical measuring apparatus of all descriptions. Transmission dynamometers and the methods of mechanical measurement are also treated. Coordinate with this theoretical instruction the entire afternoon of each day is spent in practical laboratory work in electric measuring and testing.

In the second session the work is more advanced. On the practical side the construction and operation of dynamos and motors are studied carefully and minutely; also arc and incandescent lamps, telegraphs, telephones, primary and secondary batteries, etc. In the mathematical theory the students take up the study of the laws governing constant electric flow in linear conductors, theory of thermo electricity, magnetism, electro-magnetic induction, Maxwell's dynamical theory of the electro-magnetic field, etc. The instruction in the theory of the dynamo and motor includes the characteristic and current curves of the different types of machines, construction and use of diagrams in practical work, determination of the different efficiencies, the theory of constant potential and constant current machines, etc. The laboratory work carefully follows up this instruction, and consists in the testing of dynamos, motors, batteries, etc., and also gives the students practice in the actual construction of simple electrical apparatus. Frequent visits are made to electrical factories, plants and stations.

The practical lectures of the second year are devoted to the management of dynamos, motors, engines, etc., electric lighting plants and stations, electric power, the construction and use of submarine, quadruplex and other telegraphs, the extraction, deposition and purification of metals by electricity and the theory of primary and secondary batteries. The mathematical course comprises the theory of varying currents and alternating current induction. The theory of the dynamo and motor covers the study of the alternating current dynamo and its characteristic periodic currents, measurement of mutual and self-induction, methods of measurement of alternating currents, transformers, etc. In the laboratory and workship practice is given in taking apart, putting together and repairing dynamos, motors, measuring instruments, and in the construction of electrical apparatus such as winding armatures, etc.

Conferences are held one evening each week throughout the course to discuss current electrical literature.

The students have just finished the construction for experimental purposes in the laboratory, of a battery of 1,280 cells which, when set up with Daniell elements, gives an e. m. f. of about 1,400 volts, and when set up as a storage battery, an e. m. f. of about 2,800 volts. Some interesting results have been obtained from the experiments performed with this battery.

There has just been erected in the mechanical engineering department a hydraulic testing machine of 150,000 pounds' capacity, and it is now to be used by the electrical engineering students for a series of tests which, it is expected, may be of considerable theoretical and practical interest in electrical science.

Westinghouse Electric Railway Company.

The Westinghouse Electric Railway company has been organized at Pittsburgh, Pa., with a capital stock of $2,500,000, to construct electric railways. While the concern is organized under the laws of Pennsylvania and the capital stock held largely by the Westinghouse interests, the project originated in Chicago, and the business will be conducted by three men well-known in electrical circles throughout the country, and especially in Chicago. It can, therefore, be justly termed a Chicago enterprise, especially as a large block of stock is held in the city. The projectors of the enterprise are C. C. Warren, H. Mc. L. Harding and J. L. Barclay. These men have all been prominently identified with the Sprague-Edison interests. Mr. Warren has been at the head of the Western department of the Edison business, represented by the Leonard & Izard company, since the reorganization. His connection will cease May 1, when his resignation goes into effect. Mr. Harding has been one of the principal workers in the Sprague company ever since its inception. Last October, when the Sprague and Edison interests were publicly consolidated, Mr. Harding, who had been formerly connected with the home office, came to Chicago to establish the mining department of the consolidated interests, and give his special attention to the development of this branch. Mr. Barclay has been special agent of the Sprague company in the West about three years. In that time he has earned an excellent reputation in the motor field, and has gained valuable experience.

Although the company was organized at Pittsburg, the business will be conducted at Chicago and New York, where the principal offices will be located. The Chicago department will be directed by Mr. Warren, and Messrs. Harding and Barclay will direct the affairs of the Eastern office.

The organization of the new company has been quietly effected and only a brief announcement of the retirement of Messrs. Warren, Harding and Barclay from the Sprague-Edison interests was made at the New York office, but much interest was excited. In Chicago where more was known of the movement, the announcement will not occasion less surprise. The electrical fraternity of the West and of the country in general will unite in extending to the projectors of the new enterprise their best wishes for its success.

The appointment of successors to Messrs. Harding and Barclay has not yet been announced. Mr. Warren will be succeeded by S. D. Green of New York who has been associated in the management of the United Edison company with H. Ward Leonard, formerly of this city.

Ferranti's Work in London.

In the annual report to the shareholders of the London Electric Supply corporation, Limited, S. Z. de Ferranti, the electrical engineer of the company, makes a few general statements in regard to the progress of his work. The report was substantially as follows:

"I have the honor to report that during the past year the general works and buildings at your Deptford station have been completed, and a large amount of machinery for supplying electric current has been erected. There is now in complete working order a plant consisting of two 30,000-light dynamos, with engines, boilers, and other accessories to correspond.

"In order to utilize this supply of current in London, mains were purchased and laid in the early part of last year, but I regret to say that some of them have proved a very great failure, owing to which you are not in a position to utilize more than one-quarter of the capacity of the Deptford plant. Had these mains succeeded you would now have been in a position to utilize the whole of the Deptford machinery above mentioned for the supply of the corporation's customers in town.

"The Grosvenor central lighting station has continued to supply current to a large number of consumers during the past year, notwithstanding the great difficulties attending its position in a most populous and busy district, where space and every other convenience are much limited. In order to use the plant of this station to its full advantage, and to secure the benefits of the riverside site, arrangements are now being made for its removal to Deptford, where, before the autumn, it will be in a position to contribute to the supply of light in London in a more economical and efficient manner than now. You will then possess plant capable of generating power for 90,000 lights, with which, after making most liberal allowances for reserve, you will be able to supply 60,000 lights simultaneously.

"In addition to the above, two large dynamos of the capacity of 200,000 lights each are being built. These machines will at first be used for 100,000 lights each, and the engines and boilers for this output are now completed, and the machines themselves are in a fairly advanced state, the heaviest and most difficult parts of them being well in hand. It is expected that these machines will be completed about the end of the present year, when the productive capacity of the plant will be raised to 290,000 lights, and allowing for reserve in accordance with the requirements of the Board of Trade, you will be able to supply some 160,000 lights simultaneously. At a later stage the current for 200,000 additional lights will be obtained from these machines by simply adding the necessary engine power.

"The laying of distributing mains has been commenced, and fair progress made in a portion of the corporation's area. The manufacture of permanent trunk mains by the corporation's own staff has been vigorously pushed forward, but partly on account of the time occupied in getting a new system into working order, and partly owing to the great difficulties experienced in meeting the varying requirements of the several local and other authorities, none have yet been laid. These mains have been tested on the corporation's own premises, and the results show that they are capable of withstanding greatly more electrical pressure than will be required in ordinary working, and also that they are in every sense a practical and commercial success. The defective mains now in use between Deptford and London will shortly be replaced by these permanent trunk mains, when a supply of current to the full capacity of the machinery now erected at Deptford may be utilized.

"During the past year great difficulty has been experienced in obtaining a satisfactory meter for the registration of current supplied to customers, and this difficulty has entailed a certain amount of loss to the corporation. Recently, however, several meters of a satisfactory type have been put into use, and now more than half the corporation's customers are supplied through these meters. It is believed that before very long the corporation will be able to supply all their customers by meter.

"It may be well here to remind the shareholders that in erecting its works at Deptford on a site immediately adjacent to the Thames, and upon a sufficiently comprehensive scale, the corporation has taken its lesson from the gas companies. These companies commenced with small stations in the center of populous districts, but experience has since shown that this was an undesirable method of proceeding, and that the true way to secure both economy and efficiency is to generate gas on a large scale on a commodious site at the water's edge, and at some distance from the district to be supplied. The corporation has followed this eminently practical conclusion, and when the Deptford works are further advanced the wisdom of following an example proved to be so successful in an enterprise of a kindred nature, will be apparent."

Evolution of the Electric Railway.

At the meeting of the Boston Electric club April 14, Joseph Wetzler read an unusually interesting paper on the "Evolution of the Electric Railway." After tracing briefly the history of the electric motor, Mr. Wetzler spoke of the possibilities for the still higher perfection of the electric railway system. A brief synopsis of the latter part of the paper follows:

Taking up the generator, I think it will be conceded that it has even to-day reached such a standard of perfection that little may be expected in the future in the way of an increase in its efficiency, and the changes which do take place will be more in the direction of cheaper construction, and possibly, as the tendency seems to be largely to-day, toward reduction of speed.

But when we come to the conductor by which the motor is fed with the energy necessary for its propulsion, we encounter the element which is indeed one capable of some evolution, and when we use the word "conductor" we mean not only the wire, but all those elements which are subsidiary to it, and which go to make up what we may call the conductor system as a whole. I use the word "evolution" advisedly, in contradistinction to the word "development," for while development in detail is naturally to be expected, the process of evolution which the electric railway is passing through at the present time may make entirely unnecessary the existence of such a system of conductors. I imagine that many of you have already divined what I am about to call attention to, and that is, the presence and the possibly influence of the storage battery on the progress of electric locomotion.

Though storage batteries may be said to be in successful operation in a few instances at the present day, notwithstanding the difficulties which their employment presents, due, principally, to the large weight necessary for obtaining the required power, is it likely that the art of storage battery making will remain stationary, and that no improvements in that direction are to be hoped for? I certainly cannot bring myself to believe that such is the case; indeed, I am convinced that with the large number of workers in this field, the next five years will produce a battery which will be adapted to railroad work, not only by its construction and durability, but chiefly by its lightness compared with the power which it is able to develop.

The question whether the conductors of the future in large cities will be placed underground, is, in a certain

sense, problematical, in view of the fact before pointed out, that the near future may make the consideration of conductors out of the question by the employment of storage batteries as a secondary source of energy on a car. But again, on the assumption that storage batteries will not be forthcoming, the paths open in the consideration of underground construction lead in various directions. Will it be a pair of bare conductors from which current is taken and returned by means of brushes attached to a car and projecting through a slot in the street? Or will it be one of those ingenious methods in which the conductor is insulated throughout, but connected at intervals with the track which it energizes locally at the spot which the car happens to be traversing at any instant? These are questions which it would be difficult to answer.

Still I think it is fair to assume that the overhead system will continue in use for a considerable period of time, even in the largest cities, and the evolution which may be looked for, is a thorough standardizing of all the details.

Taking up the employment of two motors, I think it is not improbable that we shall find a reversion to the older type to be the next process in the evolution of the electric railway; that is, that the motor will probably in the future be employed to drive the car, connected to either one or two axles. Let us see the reason for this. Although two motors may be built by the same hands, it is a physical impossibility to build two alike. This means that such motors placed on a car and connected to the same switch, and as a rule, connected in parallel will act unequally, one taking more current than the other, and introducing irregularities in working which one motor alone would not produce. Again, the loss which takes place on starting the car from rest to motion is almost double, when two motors are employed, as compared with the case where but one is employed, owing to the fact that at the low starting speeds, the motor has not had time to obtain its maximum efficiency of action.

Again, it not infrequently occurs that the car in starting takes anywhere from 50 to 100 amperes of current through the two motors; but I believe that experiments have demonstrated that if one motor alone is employed, the draft of current at the starting would not be nearly so heavy as just indicated.

Again, looking toward the future of heavy city traffic the question also forces itself upon the mind whether accumulated experience may not prove that greater economy is to be obtained in the use of individual electric locomotives or motors, which shall draw a train of two or more cars, instead of the present method of providing each car practically with its own motive power equipment.

Passing on for a moment to the method of connection of the motor to the car axle, I believe that those persons who have had practical experience of electric railway operation will agree with me that evolution in the direction of electric car gearing will develop remarkable changes in a very short time.

Again, as the high speeds employed in the motor are, in a great measure, responsible for these troubles, the remedy seems obvious, and is, I believe, already about to be applied in the employment of slower speed motors, and the reduction in the number of steps in the gearing from two pairs to a single pair; in other words, in the reduction of speed from 12 to 1 to something in the neighborhood of 5 to 1. This will probably involve the evolution from the 2-pole motor to a 4, or more, pole motor on the car.

As regards the return circuit of the future, whether it shall be overhead, underground, or through the earth, depends largely upon circumstances. In view of the rapid spread of æstheticism in this country, notwithstanding the noble lead which your own city has taken on the question of overhead conductors, it seems doubtful whether in many large cities that type of construction can be maintained, and granted that it is, will the present type of construction be continued? It is probable that if it is, it will resolve itself into the system which is already gaining ground rapidly, in which the main feeders will be placed underground, and the working conductors placed upon poles through the center of the street where double tracks are employed. These poles will not only be available for the suspension of electric railway conductors, but will also serve as supports for the arc and incandescent lights used in the illumination of the streets. As pointed out before, however, the question is one which, in view of the presence of the storage battery, is difficult to discuss, so far as its future aspect is concerned.

But finally, looking generally at the question of the future of electric railroading, and speculating as to its probable extension for traffic other than for street and suburban service, it is proper to consider whether the electric railway will eventually replace the steam engine for trunk lines. While such a change is, of course, by no means impossible, considered from every standpoint, it is probably one which will not come to pass for a long time, if for no other reason than the conservatism of the average railway man. But aside from this aspect of the case, an analysis will, I think, show that there are certain defined limits beyond which electric railroading may not compare with the direct steam locomotive. I have not made a sufficiently close study of this aspect of the case to give any actual figures, and I believe that we shall soon be afforded some definite information on the subject.

But there is still a field for the electric railway beyond mere city traffic, which will, I think, shortly develop into considerable proportions, and this is in the operation of branch lines to the main steam railway lines, and as connecting links between them. There are many places where such lines, in many cases less than 50 miles in length, could be economically worked on the electric system, and that the advantages afforded are already recognized is evidenced by the fact that the idea is already being put in practice.

The contract for an equipment of Edison dynamos has been awarded by the Asheville (N. C.) Electric Light & Power company to the United Edison company.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 19.—Another surprise was sprung upon the very patient and uncomplaining public by the announcement of the Gas Commission yesterday that the streets of this city would have no electric lights during the ensuing year. After all that has occurred since the war against overhead wires and poles was begun, it seems an outrage that some agreement cannot be made whereby our streets will be lighted with electricity. The subway matter is supposed to be settled in the interest of the electric light companies. The Gas Commission claims, however, that the bids for electric lighting are all exorbitant and clearly point to a combination on the part of the electric light companies. In response to a suggestion that the question of the advance in price be referred to a competent electrical engineer, Mayor Grant said: "Nothing can convince the board that the companies have not entered into a combination to increase the cost to the city of lighting its streets. I don't mean to say that there was anything dishonest, but a business combination has been formed by the companies, and certain portions of the city have been allotted to each company to get the highest pay possible for the service. I propose for my part to light the city by gas rather than give contracts at those high rates." The bids were laid over indefinitely, and people will continue to stumble along in Egyptian darkness.

The fast telegraphers are in a state of discontent, since the awarding of the first prize to Pollock, and claim that his sending was not "readable," although it is admitted by all that his work at the key was phenomenal. The fact of the matter is that Pollock was too much for the "city cracks," and the boys might just as well acknowledge it. Manager Catlin of the tournament, has received a letter from Mr. Pollock, in which he says he will decline to consider challenges for promiscuous contests. It is proposed at the next tournament to send 1,000 words of unfamiliar press matter, so that it can be copied by a typewriter.

The proposed East River Tunnel is creating a widespread interest and there is little doubt that the city will soon have a connection with Long Island which will rival Brooklyn bridge. The transit through the tunnel will be vastly superior to the service on the bridge as electricity will be the motive power. The accommodations to the public which the bridge offers need to be greatly increased. Rapid transit, for the accommodation of the immense throngs of business people who live in remote parts must be effected in some way, and the building of tunnels, bridges, and a system of railways is an absolute necessity. In all this matter electricity is destined to play an important part.

In Commissioner Gilroy's quarterly report the very astonishing fact appears that only 871 electric lights are now in use in the streets and public places in the city, and under the present arrangement these are likely to be extinguished.

Kemmler's case came up for the last time on Monday when District Attorney Rich, in behalf of Attorney-General Tabor, made a formal motion to make the judgment of the Court of Appeals the judgment of the Supreme court, and Justice Dwight, who presided, entered the order.

It is reported that the Brush electric light plant at Baltimore has been purchased by the Westinghouse Electric company.

A new electric corporation has been formed at Bridgeport, Conn., to be known as the Star Electric company. It has been established for the purpose of manufacturing all kinds of electrical supplies. A. F. Spencer, who for the last nine years has been foreman of the Bridgeport Telephone exchange, is one of the incorporators of the new company, and has severed his connection with the telephone company to take active part in the new organization.

Schuyler S. Wheeler delivered an interesting address on the "Practical Uses of Electricity" last evening, before the Harlem Branch of the Y. M. C. A.

The official announcement was made this week of the appointment of George B. Prescott, Jr., to the position of general manager of A. G. Day's business. Mr. Prescott assumed his position at once.

Among the visitors to the Lenox Lyceum this week were the delegates to the New York State Associated Press convention. They were deeply interested in the long distance telephone. Communication with Boston was secured and conversation carried on with perfect distinctness. Visitors heard not only conversation and music from Boston, but the operas, "The Grand Duchess" at the Casino, and "The Pirates of Penzance" at the Broadway. The perfected phonograph attracts quite as much interest as the long-distance telephone, and some of the best things by the best artists on the stage are reproduced with wonderful fidelity. Actors and singers visit the Lyceum every forenoon, and Mr. Wangemann, in charge of the exhibit, takes the opportunity to imprison some of their choicest words or notes for the benefit of his audiences in the afternoon and evening. The exhibition, which is under the auspices of the Exchange for Women's Work, is proving a great success.

Andrew Campbell, the inventor, died in Brooklyn Sunday evening. He was attacked by heart disease while walking on the street, and expired before he could be conveyed to his home. He was 69 years of age, and had led an exceedingly active life. He came into general prominence as the inventor of an improved printing press, now in general use throughout the civilized world. His inventive genius was not confined to this field, however. He gave much attention to the study of electrical science, and secured patents on several important devices.

The senate committee on general laws has not yet concluded its mission, it would appear, for it descended on this city last week and announced its intention of renewing its course of meddling with affairs which it has already declared its inability to regulate by legislative interference. It is about time that this farce was terminated.

W. H. T.

Des Moines, Ia.

DES MOINES, April 18.—The Des Moines Street Railway company is making extensive improvements this spring, and is expending a large amount of money. The power house now contains two fine engines, one of 150 horse power and the other of 200 horse power, both of the Corliss type, and four dynamos. Another dynamo has been purchased. The company has 22 electric cars in operation at the present time. Some of them are old horse cars fitted out with electric apparatus, but these are soon to be replaced with new cars. The old cars are used on the old horse-car tracks, which are very hard on electric cars. Four of the newer cars are equipped with Sprague motors and the others are all of the Thomson-Houston system. The company is doing an enormous business. One day last week, during the G. A. R. encampment, 12,672 passengers were carried, and the number would have been much greater but the parade obstructed the cars for more than an hour. One car register showed 1,525 passengers during the day. The company has recently secured the services of W. S. Jewell of Boston, as general superintendent of the road, and Geo. B. Hippee, who was secretary and general manager, will confine his attention to the secretaryship. The proprietor of the road, the entire street railway system of Des Moines, J. S. Polk, is also devoting his time almost entirely to the road. The old horse car lines are being rebuilt and new lines opened up rapidly, and the capacity of the road for business will be fully doubled this year.

Des Moines has had an electric road in operation a year and a half, and has never had a serious electrical accident. On several occasions workmen have been severely shocked, but no one was ever injured. One horse killed was the most serious. A few evenings ago Senator McCoy, who is a tall man, was standing on a street car platform. To steady himself, he caught hold of the roof. It was wet from rain and he received a charge which burned his hand severely and caused him much pain.

The Des Moines electric road came into existence under peculiar circumstances. It was started as a horse line to compete with an old company which had an exclusive charter for horse power. After a costly litigation the new company was compelled to take off its horses. Then it was electricity or death, and electricity was tried. Such was its success, that the old company was going into bankruptcy when all companies sold out to the present owner. The men who started the electric line were made wealthy, and four at least have invested elsewhere. R. N. Baylies has gone to Rockford, Ill., where, with W. E. Andrews of this city, he will equip a road with electricity. G. Van Ginkel last Monday took possession of the roads at Springfield and will soon have electric cars running there. John Webber has purchased lines at Atchison, Kan., and Supt. O. J. Chapman, with other Des Moines parties, has taken charge of the lines at Keokuk. Only one member of the old electric company has failed to re-invest in electric street railroads.

During the recent G. A. R. encampment the use of electricity for street decorations was shown to perfection, and the Grand Army veterans passed under many beautiful designs of colored electric points.

The legislature, which has just adjourned, considered for some time a proposition to provide for equipping all of the state institutions, such as the penitentiaries, asylums, colleges, etc., with electric lighting plants. It was the desire of those who advocated this measure that the executive council should be empowered to make contracts for equipping all of these institutions, and that it should all be done

under one contract. Nothing came of it at this time, but the movement for electric lighting is so strong that this will be done some time. A bill was introduced into the legislature also, providing for executions by electricity, but the time is not ripe for that, so it was postponed.

O. W.

Wichita, Kan.

WICHITA, Kan., April 19.—Wichita street railways will be combined and operated by electricity. At the meeting of the council recently the ordinance granting a franchise to the Wichita Electric Street Railway company was passed. The franchise provides that the company shall have eight miles of electric railway in operation within four months. The Riverside & Suburban line and the city line will be combined under one management and electricity substituted for mule power on the city lines. The franchise will be accepted by J. O. Davidson, president of the company.

A petition from the Wichita Electric Street Railway company, asking for a twenty-one year franchise to equip and operate its lines by electricity, was read in the council meeting and a franchise was granted. The company pledged itself, provided the franchise was granted, to have fully eight miles of electric street railway in operation within four months. This company is formed by a consolidation of the Wichita Street Railway company and the Riverside & Suburban Electric Railway company. The new corporation was chartered a few days ago with a capital of $1 000,000. It is estimated that it will cost fully $100,000 to make the necessary alterations in changing the present mule lines to electric lines. The franchise specifies that cars shall not run at a greater speed than six miles an hour in the business portion of the city, and that in turning corners the speed shall be reduced to three miles per hour, while in the suburban portion of the city the speed shall not exceed fifteen miles per hour. The franchise requires that the company, within four months from the granting of the franchise, shall equip Main street and Douglass avenue, and Topeka avenue with electric cars.

It was specified that iron poles should be used alooq Main street and Douglass avenue, placed in the middle of the street where double tracks are used. It was specified that iron poles should be placed in the middle of Douglass avenue from Fifth avenue, where the double track ends, east to Hydraulic avenue. The directors of the company are J. O. Davidson, Thos. G. Fitch, George L. Rause, B. H. Campbell and C. A. Walker, all of Wichita.

The decision in the case of the Missouri & Kansas Telephone company vs. the city has been rendered. The court refuses the injunction oo the agreement of the city to refrain from interference with the company's property until the case can be determined in the Supreme court. Twenty days were allowed for making up the issues.

The Postal Telegraph company's wires have reached Wichita. The local managers have leased spacious offices and the district headquarters will be located here. The line will at once be pushed through to Texas and Galveston.

The directory of the Wichita electric railway has decided to locate the power station of the new system at the corner of Tenth and Wichita streets. The company has secured a plat of ground, 120x400 feet on the Missouri Pacific tracks, whicb will make a most desirable location for a central station.

The Riverside & Suburban station at present is supplied with 220 horse power. There will be added at the new station 280 horse power. The Thomson-Houston company is already commencing to figure on the plant, and it is desired to commence work within a few days.

R.

Milwaukee, Wis.

MILWAUKEE, Wis., April 19.—The electric street railway car has taken Milwaukee by storm. For many years Milwaukee has depended upon mules and horses to haul her street cars, although other cities which possess less conservatism than the metropolis of Wisconsin have been enjoying rapid transit, and now that Milwaukee's turn has come the people here feel like a man who has just been elected to office. There has been quite a contest between the Hinsey people and the West Side Railway company as to which should get its electric system in running order first. Both are overhead lines. Hinsey might have won had it not been discovered that his poles were too short and weak. The Board of Public Works forbade the operation of the line. Hinsey proceeded to put in new poles, which are handsome trussed affairs, at an expense of more than $20,000. The work has just been completed and cars will be running over the line by next week. The Becker people, on the other hand, did not strike any snag, and electric cars have been running on the line for several days. Becker uses the Sprague system and Hinsey the Thomson-Houston system.

The three other street railways of the city—the Cream City, the Milwaukee City and Milwaukee & Whitefish Bay—will begin using electric motors during the present season. The two last companies will each build several miles of new lines. The Milwaukee & Whitefish company, which runs between the northern section of the city and Whitefish Bay, on Lake Michigan, a distance of about four miles, has secured a franchise to build to the western city limits along North avenue, and is seeking a franchise to build through the East and South sides to Bay View. The Milwaukee City Railway will extend its National avenue line to the Soldiers' Home, and will make other extensions.

"If an electric car scares a horse and the horse runs away and scares a second horse, and the second horse runs away and knocks down a ladder, and the ladder strikes a fat woman, who falls upon a small boy and crushes him, against whom can the administrator of the boy's estate maintain an action for damages?" is the question that the young law students of Milwaukee are discussing.

Henry Villard, who is at the head of the parent company in New York, visited the site purchased for the Milwaukee Edison Electric company's plant and formally approved it. The site is located on the northwest corner of River and Oneida streets. Manager Tweedy states that the company will be furnishing light by next fall.

The contract of the Badger Electric Light company, in which Chicago capital is principally interested for lighting the streets of Milwaukee, will expire in about a year and there is considerable question as to whether it will be renewed. One thing is quite certain, and that is that the contract will not be renewed at the present price—$150 per lamp per year. The city is not likely to engage in the lighting business itself, for a while at least, but there will be a competitor for the contract.

C.

Louisville, Ky.

LOUISVILLE, April 18.—The greater part of the wires which were destroyed by the tornado little more than two weeks ago have been replaced. With a great effort Manager Gifford of the Ohio Valley Telephone company, has restored about all his lines, half of which were rendered useless. The Telephone company has had an extraordinary force of linemen at work. They were secured from Chicago, St. Louis, Cincinnati and other cities.

The service on the electric street railway was suspended only two or three days. All of the most important lines of the Western Union have been restored, though that company has by no means as many working wires in the city as it had before the tornado. The railroad companies have most of their lines in working order.

Preston Wise, a former employe of the Ohio Valley Telephone company, has brought a damage suit for $2,000 against the Central Passenger Railway company and the Louisville Electric Light company. Last August, he alleges, he received a serious electric shock from a guy wire which had been charged by electricity from the railway plant.

For several days reports have been circulated to the effect that the Gas company had purchased the plants of the Brush and the Louisville Electric Light companies. Chas. D. Pearce, president of the latter company, says that the rumor is absurd. The Rock Gas company and the Louisville Electric Light company have several mutual stockholders and the former agreed not to oppose the petition of the Louisville Gas company to the legislature to amend its charter so as to enable the company to operate an electric plant, provided the Louisville Gas company would surrender its exclusive right to manufacture fuel gas, thereby giving the Rock Gas company an opportunity to compete. The mutual concessions are about to be made, and there will be no sale of plants.

B A.

Pittsburg, Pa.

PITTSBURG, April 19.—There is perhaps not another city in the Union, where the people have so readily grasped the great advantages of electricity as the motive power for street cars, as in the "City of Natural Gas." It is scarcely a year ago, since the project of an electric street car was first broached in this city, and to day there are no less than 25 miles actually operated by the electric motor system, with a capacity of 75 cars.

There is at first the Pleasant Valley Passenger Railway company, with a perfect network of street car lines between Pittsburg and Allegheny. The Sprague electric motor system has been adopted by that line, and from the first day of its operation until now the service has been greatly appreciated by the public. The company has left no stone unturned to give its patrons rapid transit in the most approved style. The receipts of the road have correspondingly increased, and the operations of the line are constantly being extended. Only a few years ago the compaoy decided to carry the main line to Bellevue, a suburb of Allegheny City, and when that is completed the road will run from the center of the business portion of Pittsburg, a direct distance of seven miles.

The other electric railway line is operated by the Second Avenue Street Railway company, which runs cars from Market street, Pittsburg, to Glenwood, a distance of four miles. The Thomson-Houston motor system has been installed on this line. The first car ran on April 1, and the travel has already increased to such an extent that the company has been compelled to order an additional number of cars.

There are several smaller roads in operation by electricity and a number are now being built. Among the latter is the Duquesne Railway company's lines, which are operated by the Duquesne Traction company. This corporation has secured a regular omnibus charter, covering nearly every alley, street and avenue in Pittsburg, and the intention is to cover them with tracks for an electric road. The company has ordered 100 cars already, and it is expected to have a part of the road in operation by next fall.

The Birmingham Street Car company, one of the oldest corporations of its kind in the country, is also going to abandon its horses and use instead the Thomson-Houston electric motor system for the motive power of its cars. This road is owned by H. Sellers McKee, a Pittsburg millionaire glass manufacturer, who is at the head of a syndicate controlling $20,000,000 worth of street car lines. It might be interesting to mention that it was at first intended to adopt the cable system on this road, but a closer investigation very soon convinced Mr. McKee that it would answer his purpose a great deal better to use electricity.

The Westinghouse Electric company is installing its apparatus for a large electric light plant in the city of Allegheny. The construction work on this plant includes the erection of a large number of towers, which are to be placed at certain squares in the town. About these towers the Pittsburg *Post* makes the following ostensibly facetious remarks in its editorial paragraphs:

"The new electric light towers in Allegheny—veritable sky scrapers—certainly are given an appearance of insecurity by being hoisted up and seemingly poised on a single standard. But timid people may reassure themselves with the reflection that capital is traditionally conservative—and as the fall of one of these contrivances would involve the loss of many dollars, as well as the perhaps minor matter of a few human lives, it is safe to say that the topply-looking towers are put up to stay. They cost too much for the company to take any chances of their falling on folks."

The Allegheny police committee met last night and elected an electrician to take charge of the wires of the patrol service, a duty that will require all of his time for some months. Ever since the work has been given up by Chief Jones of the fire department, the wires have been wholly unreliable. Lately they have become worse than ever, and when an officer makes an arrest now he takes his prisoner to the nearest telephone and calls for a patrol wagon through the mayor's office instead of calling from a patrol box. At the meeting a few days ago Mayor Pearson called the attention of the committee to the matter, and handed in a number of applications from persons desirous of being appointed to look after the wires. The committee united on the name of H. E. Dillon, an electrician of ten years' experience, who had a number of good letters of recommendation.

The Westinghouse Electric company has brought suit against the Frankford Electric Light company of Philadelphia to recover $7,885 for material and labor employed in constructing defendants' arc light station in that city.

The New Brighton & Beaver Street Railway company and the Beaver Valley Street Railway company have consolidated. They will now build an electric line and extend their line to Beaver, a distance of seven miles.

The teamsters of Pittsburg and Allegheny have discussed in their local assembly the alleged carelessness and insolence of the motor men of the Pleasant Valley Street Car company. They claim the men run their cars too fast and will not give a teamster enough time to get his wagon off the track. The drivers complain greatest of the fast running on Anderson street, Sandusky street and Fremont street.

The Suburban Electric Railway company of the South side, this city, has adopted a novel custom. It will substitute chartered cars for funeral carriages. A side track has been placed in the vicinity of the gate of the South side cemetery, and on this side track the cars will remain during the services in the cemetery.

The new apparatus for the city bureau of electricity is about completed. Chief Brown, during his recent trip East, looked at some of the machinery at the factory in New York, and he said the other day that it all will be shipped during the present month.

The Zanesville Electric Street Railway has been incor-

porated with a capital of $50,000. The incorporators are H. H. Sturtevant, F. S. Gates, Wm. Bateman, H. C. Werner, C. U. Shyrock and W. H. Shyrock of Baltimore, Md. The company expects to expend at least $100,000 in establishing the plant. The present street railway company has also announced its intention of abandoning mule power for electricity.

The Westinghouse Electric company has decided to go into the electric road business. The company has made all the preparations to commence the manufacture of the motors immediately. The present capacity of the works is to be considerably increased.

The East End Electric Light company of this city is about to extend its operations to a degree that will make this city one of more light at night than any other in the country. The company will extend its operations to Hazelwood, Glenwood, Homestead and Sharpsburg. A plant will be built at the latter place, and President A. T. Rowand has bought four acres of land at Hazelwood, where a power house is to be erected. When all these places mentioned are illuminated, Pittsburg will probably have the largest capacity of electric lights in operation of any city in the Union. The East End Electric Light company has now a capacity of nearly 20,000 incandescent lights, which will be doubled after these extensions are made. The Allegheny County Light company, another corporation, operates now a plant of 30,000 lights, and it is also constantly increasing its capacity. Besides these there are several smaller companies. The two largest, however, are both using the Westinghouse systems of alternating current incandescent and arc lighting. H.

THE ELECTRIC LIGHT.

Harrisonburg, Va., will be lighted by electricity.

The Lowe-Geeding Electric company of Neosho, Mo., recently took a contract for installing a 50-light plant for the Mammoth Springs Improvement company, of Mammoth Springs, Ark.

At the annual meeting of the Little Rock, Ark., Edison Electric Light & Power company M. Q. Townsend was re-elected president, and W. S. Allen having resigned the vice-presidency, Nick Peay was chosen to fill the vacancy. A. S. Van de Mark was elected superintendent.

The Levens Electric company has secured the contract for the electric work in the Park Hotel at Hot Springs, Ark. A 300 number Partrick & Carter needle annunciator with fire alarm and guest call will be used. The Partrick & Carter combination bell and push button will be in every room.

Robert Commons has been appointed chief engineer at the United States government building, Chicago, to succeed M. B. Bailey, who has held the position for twenty-two months. The change was made for political reasons. During the last 433 days, Mr. Bailey states, the electric plant has been out of service only 28½ minutes. Mr. Commons, the new appointee, is a thoroughly competent engineer, and has held a position at the West Side waterworks.

The Chicago Edison company will extend its mains through Wabash avenue, so as to supply current to the Hotel Gage, which is being refitted, and the Andrews Furniture company. The Hotel Gage will have 1,100 incandescent lamps, and the Andrews building 700. Both are being wired by the Edison company. The Chicago Edison company has closed contracts with the following named companies for isolated plants: Illinois Steel company, South Chicago, 400 lights; Otto Young, Chicago, 350 lights, and Rudolph Weber, Chicago, 500 lights. The Hyde Park hotel, which has had a 375 light plant, will soon replace the present machine with two Edison dynamos. The new building will also be illuminated by electricity, 675 lights being used in the addition. A power house will be constructed apart from the hotel buildings.

At a meeting of the executive committee of the National Electric Light association in New York April 14th, the resignation was received and accepted of M. D. Law, a member who has left for Denver. C. H. Wilmerding of the Arc Light & Power company, Chicago, was elected in his place. R. W. Ryan was appointed official stenographer for the next convention. F. T. Walton, A. J. DeCamp, J. J. Burleigh, John A. Seely and the secretary were appointed an entertainment committee, with power to fix the date of the semi-annual meeting at Cape May next August. Messrs. Lockwood of Detroit, Wilmerding of Chicago, and Mason of Boston, are to secure suitable papers for the Cape May convention. Allan V. Garratt resigned his position as secretary and treasurer, to take effect June 15th, and Allen R. Foote was appointed in his stead.

The United Electric Light & Power company, of New York City, has just placed with the Westinghouse Electric company an order for an alternating current incandescent apparatus to increase its present capacity of 28 000 lights to the extent of 15,000 lights. To fill this order, five 3,000 light dynamos will be as soon as possible shipped from Pittsburg. Once these machines are in the station of the United company and in operation, that organization will have the largest central station incandescent lighting plant in the United States. Its arc lighting business is likewise growing with great rapidity; it is now employing the new Westinghouse alternating current arc lighting system to a total capacity of 1,800 lights and last week was obliged, in order to keep up with the demand for light, to order an additional 125 light machine from the Westinghouse company.

The scheme for lighting the buildings at the Edinburgh exhibition is an elaborate one. The arc light circuits will involve the use of considerably over twenty miles of wire. The dynamo court measures 120 by 80 feet in the center of the machinery hall. The Brush Electrical Engineering corporation have contracted to light the buildings and grounds by means of 351 arc lamps, each of 2,000 candle-power. The current will be generated by thirteen dynamos of the old Brush type, each capable of running thirty-five lamps and two of fifteen lamps each, which will be used for "pilot" or police circuits. King, Brown & Co. of Edinburgh will introduce a special installation for the concert hall. This room will be illuminated by 110 sunbeam lamps, each of 200 candle power. The current is to be generated by four powerful dynamos of King, Brown & Co.'s manufacture. Besides these arrangements, numerous private firms will contribute to the illumination of the stalls and courts; while besides it will be arranged that certain portions of the grounds will be prettily decorated with colored electric lamps.

THE ELECTRIC MOTOR.

The Tacoma (Wash.) city council has granted franchises for the construction of four double-track overhead electric lines on the principal streets of the city. The electric system is growing in popularity in Tacoma.

The St. Louis Railway company has notified the Board of Public Improvements that its crossings at Broadway and Washington avenue will be after the plan approved by the board for the Lindell Street Railway company.

The St. Louis Merchants' Bridge Terminal Railway company have asked the Board of Public Improvements for the privilege of placing their poles along their track instead of along the curbing of the street, as prescribed in their agreement with the board. As the city will gain by the change, the board will probably grant the railway company the privilege.

The Fort Wayne & Elmwood Railway company at Detroit has been operating a storage battery car on its lines since April 1st. The car is one of the finest ever turned out by the Pullman company of this city, and is finished in mahogany with white silk curtains over handsome plate glass windows. It is operated on the Shawhan system, Baltimore trucks and 80 cells of Woodward batteries. The tests thus far have proved satisfactory.

It would be singular if the first long-distance electric road should be established in far-away Russia. Such a thing, however, seems more than probable, for a project is now on foot to connect St. Petersburg with Archangel, a distance of 500 miles, by an electric railway. The enterprise, with which the name of Siemens is connected, is backed by Archangel interests, and the estimated cost of the road, including rolling stock, will be $15,000 per mile.

The Thomson-Houston company has secured the contract for the entire equipment of the West Street and North End Electric Railroad company's lines at Seattle. The stringing of the overhead wires will be different from the system now used in Seattle. Iron posts will be placed between the two tracks every 100 feet, with arms projecting on each side over the tracks from which the wires will be suspended. A cluster of five incandescent electric lights will be placed on every other pole. The contract stipulates that the entire system must be completed by July 1st.

A Denver correspondent writes: The popular agitation of the people of North Denver for more direct communication with the city is about to materialize. It has been evident for a long time that more car lines were needed, especially in the section between the Berkeley motor and the West Colfax lines. The Tramway company has made propositions for putting in electric railways, which are now being considered by the people. There are several routes under consideration, one being on Ashland avenue, from the tramway loop to the county line, a distance of two miles. Another line proposed is from Ashland to Sixth street, thence along that line to Agate, and along the latter to Sloan's Lake. This line the Tramway company offers to put in operation for a subsidy of $20,000. Several deviations from these routes are being considered, but these are the favorites, though it is not impossible that there will be other lines.

The Lindell Railway company of St. Louis last week filed its acceptance of the provisions of the ordinance passed during the recent session of the municipal assembly, giving the railway company the privilege of changing its motive power to electricity. Work has already begun on the erection of poles for the wires and the laying of rails preparatory to the introduction of electricity. The other railway companies that have succeeded in having ordinances passed by the assembly, giving them the right to change their motive power, will probably soon file their acceptance of the provisions of the ordinances granting them the right to make the change. There are eight street railways having authority to use electricity along their lines, through ordinances passed during the late session of the municipal assembly. Several have already begun to tear up their tracks and lay the electric wires, and the whole number will be at work before the first of next month.

Among the recent contracts of the Sprague Electric Railway & Motor company is one for the equipment of the Augusta street railway, the principal street railway in Augusta, Ga. The equipment of this road, which will be in operation before long, will be first-class in every respect. The cars to be equipped with electric motors are 16 in number, and each will carry two 15-horse power motors. At the station the generating plant will consist of two 80,000 watt dynamos for supplying the necessary current for the line, which will be more than 15 miles in length. The line of the route passes the Union Depot, Opera House, and the principal points of interest in the city. After leaving the center of the city, the street car tracks are laid in the center of the boulevard in the residential districts in which the roadway lies on each side. The center strip, which occupies a space of about 60 feet between the roadways contains a double row of large elm trees running the entire length of the boulevard, so that the poles required for span work are almost entirely hidden by the foliage and are so rendered unobjectionable even to the most critical eye. The space between the tracks will be covered with turf, so that the tracks will not be noticeable at a little distance. It is hoped that five cars will be in operation by May 15, and the rest of the equipment will be in operation by June 15.

It is understood that a Northern syndicate has secured control of the electric interests in the towns of Winston and Salem in North Carolina, and that an electric line, connecting the two towns will soon be installed. The line will be five miles long, and will include six cars. The Sprague system of overhead wiring will be used. The dynamos will be located in the electric light station which will hereafter supply both light and power for the street cars and general industries along the line. This is probably the first station in the country from which will be distributed electric power for street railway and general industries, and light by both arc lamps and incandescent. Among the incorporators of the company mentioned, are E. H. Johnson, J. H. McClement, F. J. Sprague and E. B. Hawkes. Although electric roads are now in operation pretty generally throughout the Northern and Western states, the use of electricity as a method of propelling cars, has not as yet, met with such wide adoption among the cities of the Southern states. There are, it is true, a number of cities in the South where there are electric roads in operation, or in process of construction, but the horse and mule are still relied upon in most cities for the operation of the street cars. Northern capital, however, is rapidly developing many of the Southern towns, and a few years change a locality from a condition of inertness to one of business and enterprise.

It is stated that the Sprague Electric Railway & Motor company have closed a large number of contracts for the electrical equipment of street railways during the last month. These contracts came from all over the country, a large number of them being noticeably from street railway companies which already have a number of cars in operation upon the Sprague system. No argument of the popularity of electric railways could be made more convincing than this fact, which is so common, of additional equipments ordered by street railway companies where the system has been tried. A street railway company may be dissatisfied by an electric system before the road has been put in actual operation, but when a company continues to order additional equipment there is only one conclusion to be drawn—*i. e.*, that the system is a success. The most recent contracts of the Sprague company are as follows: Augusta Street Railway, Augusta, Ga., 16 car equipment; Paducah Street Railway, Paducah, Ky., 9 car equipment; Fort Worth & Arlington Heights Railway, Fort Worth, Tex., 3 car equipment; Troy & Lansingburgh Railway, Troy, N. Y., 12 car equipment; Metropolitan Railway, Portland, Ore.; Passenger & Belt Railway, Lexington, Ky., 4 car equipment; Atlantic City (N. J.) Electric Railway, 1 car equipment; Detroit, (Mich.) Rouge River & Dearborn Railway, 4 car equipment; Union Street Railway, St. Joseph, Mo., 6 car equipment; Sioux City (Ia.) Street Railway, 5 car equipment; Dallas (Tex.) Rapid Transit Railway, 1 car equipment.

THE TELEGRAPH.

A decision has been reached in the case of the Great Western Telegraph company's litigation over the attempt to collect an assessment of 35 per cent. on the capital stock. The case in point was the first tried in Iowa, and is considered a test. In 1867 to 1869 many citizens of Iowa subscribed to the capital stock of the telegraph company. The company soon thereafter contracted a large indebtedness and being insolvent passed into the hands of a receiver in 1874. In 1886 an assessment of 35 per cent. of the stock was made, and the receiver brought this, the first action in Iowa to collect the amount. There were many defenses pleaded, and the issues involve many intricate questions of law. Judge Phelps gave the case a thorough consideration and decided in favor of the defendant. The case will probably be taken to the Supreme court as a test case by the receiver.

The Chinese government is making rapid progress in the introduction of the telegraph. For years the Chinese were aware of the advantages which foreigners derived from the employment of telegraphy, but they did not think that the conditions of the country required it, and it was not until 1877 that a start was made by the Great Northern Telegraph company. The campaign of 1880 in Kuldja showed the necessity of a speedier means of transmitting news to the army, and the same thing was demonstrated in the troubles with France in Tonquin. Since these dates great extensions have taken place, and now the Chinese telegraph system adjoins that of the French in Tonquin and that of the Russians at Kiachta, and in a few months the junction will be complete. While the military uses of the telegraph have always been kept prominently in view, it has also become of great importance for commercial and general purposes, and all the latest important information is now sent from Europe to China, so that the telegraph is likely to be a very important factor in the awakening of China.

Miscellaneous Notes.

A simple method of curing creeping of salts on batteries is described by Ernest Gerard. This is to smear the surfaces to be preserved with a thin coat of vaseline. The vaseline is unchangeable by air, is not attacked by most

chemicals, applied easily, keeps in place, and does not cover up from sight the parts to be protected.

The King of Siam has been induced to allow the introduction of electric apparatus in his domain. A telephone exchange has been established, and an electric light station is in course of construction.

A letter from Ira Cornwall secretary of the exhibition of St. John, N. B., states: "I am instructed by the manufacturers' committee of the exhibition, which is to be held in this city during the coming season, to inform you that they will be prepared to furnish space and power free of charge, and to offer every facility for the display of electrical apparatus of all classes."

The twenty-fifth annual catalogue of the Massachusetts Institute of Technology, Boston, is an exceedingly interesting document to those interested in the work which this excellent institution has been prosecuting so faithfully since its inception, and possesses more than ordinary interest for electrical workers especially. The laboratories are thoroughly equipped with apparatus for tests and measurements in electrical experiments, thus enabling the student to combine with his theoretical discussion a practical application of the principles under consideration. The course in electrical engineering is extending constantly to meet the requirements of the times. Beginning with thorough instruction in the theory of electricity, an extended course of lectures is devoted to the consideration of the various technical applications of electricity to land and submarine telegraphy, the telephone, electric lighting, and the electrical transmission of power. Instruction is given by lectures and laboratory exercises upon the processes of photometry, especially as applied to the measurement of electric lights. Advanced instruction in electrical measurements, including work with dynamo-electric machinery, together with a course on the electrical testing of telegraph and telephone lines, is provided. The subjects of construction, specifications, and contracts also receive attention. Besides the regular course of instruction, lectures are frequently given by gentlemen who are professionally engaged in the several departments of electrical engineering, or especially conversant with certain branches of applied electricity. In order to provide for the needs of students seeking instruction in electrical engineering beyond that given in the undergraduate course, an advanced course has been planned, which, if the student so desires, may lead to the degrees of Master of Science or Doctor of Philosophy. To this end, in addition to guidance in the prosecution of experimental research, provision will be made for the further study of the mathematical theory of electricity, of analytic and applied mechanics, including the theory of elasticity, the dynamics of rigid bodies, and hydrodynamics, and also of advanced mathematics.

Personal Mention.

E. Ward Wilkins of Partrick & Carter, Philadelphia, was in Chicago last week.

Emer L. White, treasurer of the Standard Underground Cable company, Pittsburg, was in Chicago this week.

Business Mention.

The Magnolia Anti-Friction Metal company is sending out a handsomely gotten up book containing a short romance entitled "Luxilla."

The Wainwright Manufacturing company of Massachusetts reports that it has had large orders for its heater and condenser during the last few months.

The National Engineering bureau has opened an office in the Rookery, Chicago. Thomas G. Grier and James A. Loonsbury, both competent engineers, are in charge.

The Eddy Electric Manufacturing company of Windsor, Conn., has opened an office at 329 Rookery, Chicago, for western business. The office is in charge of G. A. Edward Kohler, who is well known to the electrical fraternity.

The Link-Belt Machinery company of Chicago has issued a comprehensive circular illustrating and describing the workings of the link belt disk friction clutch which it manufactures. It is claimed that it is particularly designed for electric light stations.

The Knapp Electrical works, Chicago, has just received a fine line of incandescent globes and shades made from special designs, for this establishment. This house also has secured the exclusive Western agency for the Crosby dry battery for open circuit work, and is pushing it prominently to the front.

Jas. H. Mason has established an office at 63 Broadway, New York, where his celebrated primary battery can be inspected from one to four o'clock P. M. The Empire City Electric company is agent for New York, and the prospect for large sales during the summer is good, as Mason's motor, fan and battery outfit are giving satisfaction wherever used.

It is announced that the business of the late Edward P. Allis of Milwaukee, has been reorganized under the form and corporation name of "The Edward P. Allis company." The officers of the company are Wm. W. Allis, president; Edward P. Allis, Jr., first vice-president; Edwin Reynolds, second vice-president and superintendent; Chas. Allis, secretary and treasurer.

H. T. Paiste, of Twelfth and Market streets, Philadelphia, reports that he is doing a large trade in his porcelain pendant cut-out and rosette. His factory for some time has been crowded with orders from supply houses throughout the country. This cut-out has been considered by those who have seen it one of the neatest ever placed on the market. The outside of cut-outs made of porcelain is often disfigured by the screw that holds the brass parts inside the cap. Mr. Paiste, by an ingenious arrangement, has perfected a method by which he has entirely done away with this.

Electrical Patents.

Issued April 15, 1890.

425,413. Balanced Pen for Autographic Telegraphs. Harry Etheridge, Pittsburg, Pa.

The invention consists in the combination, with the receiving armature rod of an autographic telegraph, of a fountain-pen provided with a reservoir, said pen pivoted centrally with reference to said reservoir to said armature-rod and having its writing point end slightly heavier than the other, whereby said pen will rest on the paper with the same slight pressure, whether the reservoir is empty or filled.

425,435. Brush Holder for Dynamo-Electric Machines or Motors. Frederick A. LaRoche, Philadelphia, Pa.

425,466. Car-Telegraph. William F. Stevens, Joppa, Md.

425,470. Distribution of Electric Currents. Elihu Thomson, Lynn, Mass.

425,488. Contact Device for Electric Railways. Francis O. Blackwell, New York, N. Y.

Claim eight follows:

"The combination, in a contact device, of an upwardly-extending rod and a spring actuating the said rod about a center and pressing it upward with a contact-piece at the outer end of said rod having an independent spring and a pivotal attachment to the rod."

425,489. Electric Railway Contact. Francis O. Blackwell, New York, N. Y.

425,493. Method of Transferring Batteries. William B. Cleveland, Cleveland, O.

425,507. Electric Snap-Switch. Cornelius J. Hamilton, Philadelphia, Pa.

425,511. Telegraph-Transmitter. Francis W. Jones, New York, N. Y.

425,513. Insulator. William P. Kookogey, Brooklyn, N. Y.

425,568. Thermo-Electric Battery. John Edelkamp, New York, N. Y.

425,570. High and Low Water Alarm for Boilers. Albert C. Griggs, Wilmington, Del.

425,572. Cloth-Cutting Machine. Maurice Hofheimer, New York, N. Y.

425,576. Signal Box. Morris Martin, Malden, Mass.

425,579. Electric Meter. Victor Popp, Paris, France.

"Claim 2. The combination, with electric lights in multiple arc, of a switch and magnet in the main circuit, a pneumatic clock, a controlling valve therefor, a connection between the valve and the armature of the electro-magnet, and a retractile spring, whereby the time during which a group of electric lamps is in use may be measured by a single apparatus."

425,588. Cut-Out. Elihu Thomson and Edwin W. Rice, Jr., Lynn, Mass.

425,594. Electric Call. Jacob B. Currier, Lowell, Mass.

425,597. Receiving Apparatus for Cable Telegraphy. Patrick B. Delany, New York, N. Y.

425,615. Insulating Compound. Adolphus A. Knudson, Brooklyn, N. Y.

425,625. Electric Temperature Controller. Emer H. Parker, Evanston, Ill.

425,627. Electric Car Motor. Edgar Peckham, New York, N. Y.

425,630. Electric Call. David H. Rice, Lowell, Mass.

425,631. Telephone Bell and Connection. David H. Rice, Lowell, Mass.

425,640. Guard for Electric Railway Trolleys. Elihu Thomson, Lynn, Mass.

425,653. Motor Truck for Cars. John A. Brill and Geo. M. Brill, Philadelphia, Pa.

425,694. Trolley. Wallace Porter and Henry George, Wilkesbarre, Pa.

425,720. Safety Attachment for Electric Railway Trolleys. Franklin C. Wheeler, St. Joseph, Mo.

425,726. Cut-Out. Charles Batchelor, New York, N. Y.

425,741. Incandescent Lamp Socket. James J. Bradley, Harrison, N. J.

425,757. Electric Heating Apparatus for Electric Railway Systems. Mark W. Dewey, Syracuse, N. Y.

Claim six follows:

"6. In an electric railway, a supply circuit extending along the way, traveling vehicles, electric motors on said vehicles electrically connected to the supply circuit to propel the vehicles, and electric heaters to heat said vehicles and connected in the supply circuit in series."

425,760. Measurement of Electricity in Distribution Systems. Thomas A. Edison, Menlo Park, N. J.

"Claim 1. The combination, in a system of electrical distribution employing a complete metallic circuit, of a meter located in circuit between one side of the system, and the earth at the point of generation."

425,761. Incandescent Lamp. Thomas A. Edison, Menlo Park, N. J.

The invention consists in an incandescing electric lamp statically charged with electricity of such character as to neutralize the static charge imparted by the current when the lamp is in use.

425,762. Cut-Out for Incandescent Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J.

425,763. Commutator for Dynamo-Electric Machines. Thomas A. Edison, Menlo Park, N. J.

425,767. Electric Railway. Thomas A. Evans, San Francisco, Cal.

425,768. Table-Ware for Ships. Frank Ezell, Selma, Ala.

425,777. Electric Door Opener. William L. Godfrey, Brooklyn, N. Y.

425,801. Electric Lighting System. Frederick Johnson, Brooklyn, N. Y.

425,818. Secondary Battery. James F. McLaughlin, Philadelphia, Pa.

425,819. Secondary Battery Electrode. James F. McLaughlin, Philadelphia, Pa.

425,853. Electric Circuit for Telephone Purposes. Arthur W. Berne, New Orleans, La.

425,862. Multiple Telephony. John J. Carty, New York, N. Y.

"Claim 1. A through metallic telephone circuit extending between two terminal stations and one or more intermediate metallic electrical circuits superimposed thereon, and extending between any two given stations on the said through circuit, one of the conductors of each superimposed circuit being formed of the two sides of that section of the through metallic circuit which exteods between the two stations of the superimposed circuit, serving jointly as a substantially single conductor, and having for its other side or conductor a separate and independent wire, also extended between the said stations."

425,863. Telephone System. John J. Carty, New York, N. Y.

The invention relates to telephooe systems and consists in the combination of a series or group of metallic telephone circuits extending each from a central station to a separate sub-station, a telephone transmitter at each sub-station included in its own metallic circuit, and an energizing battery for the said transmitters common to the group and connected with all of the said metallic circuits, the two wires of each of the said circuits being connected with one pole of said battery, thereby constituting jointly a practically single conductor for the battery current in multiple arc or parallel circuit with the other similarly constituted single conductors of the group."

425,866. Electric Railway Car. Mark W. Dewey, Syracuse, N. Y.

425,883. Electrically Propelled Car. Rudolph M. Hunter, Philadelphia, Pa.

425,902. Secondary Battery. Gustave Philippart, Paris, France.

"Claim 1. In the art of constructing secondary batteries elements, the improvement consisting in impregnating a sheet of fabric with a mixture of active material and glycerine or other liquid by compression, and applying the sheet thus impregnated to a conducting support."

425,903. Appliance for Preveoting Incrustation. William H. Porter, Washington, D. C.

425,911. Electric Railway. Richard V. R. Sill, Detroit, Mich.

Claim three is appended:

"In an electric railway, a car having its wheels insulated from their axles, a converter on the car having its primary connected with two diagonal wheels of the car, and its secondary with the poles of an electric motor.

425,912. Electric Railway. Richard V. R. Sill, Detroit, Mich.

425,913. Wire Conduit. Andrew J. Smith, Soldiers' Home, Kan.

The invention consists in a conduit made of hollow bricks and formed into a street curbing, certain of said bricks having a vertically sliding removable shutter dovetailed into said bricks, whereby access may be had to the conduit.

425,917. Electric Conductor. Eugenio Tortora, Florence, Italy.

"Claim. The improvement in tubes for inclosing electrical conductors, comprising a series of glass boxes of wedge-shaped or inclined side bases hermetically sealed or connected together, the narrow end of one box being inserted in the widened end of the adjacent box."

425,923. Method of Operating Synchronous Alternating Current Motors. Carl Zipernowsky, Buda-Pesth, Maximilian Deri, Vienna, and Otto T. Blathy, Buda-Pesth, Austria-Hungary.

"Claim. The mode herein described of operating a synchronous alternating current motor by starting the motor without short-circuiting the magnet windings, and by short circuiting them at each reversal of the current when synchronism is reached, and introducing a suitable resistance in the supplying circuit."

425,929. Engraving Machine. Charles C. Bruckner, New York, and Samuel W. Balch, Yonkers, N. Y.

425,950. Electric Railway. Walter H. Knight, New York, N. Y.

425,957. Secondary Battery. Gustave Phillippart, Paris, France.

425,959. Galvanic Battery. Louis M. J. C. C. Renard, Meudon, near Paris, France.

425,961. Electric Conductor. Philip Seubel, New York, N. Y.

425,963. Electric Switch. Ernest P. Warner, Chicago, Ill.

425,964. Electric Railway System. David G. Weems, Baltimore, Md.

425,965. Electric Railway. David G. Weems, Baltimore, Md.

425,966. Electric Railway. David G. Weems, Baltimore, Md.

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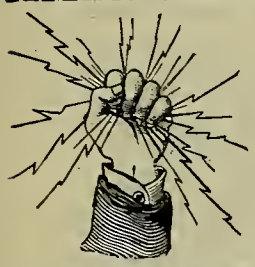

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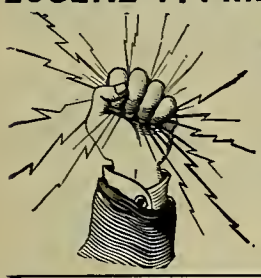

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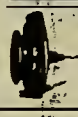

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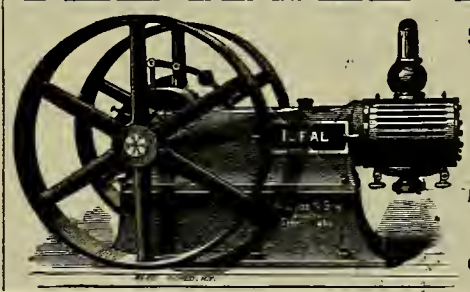

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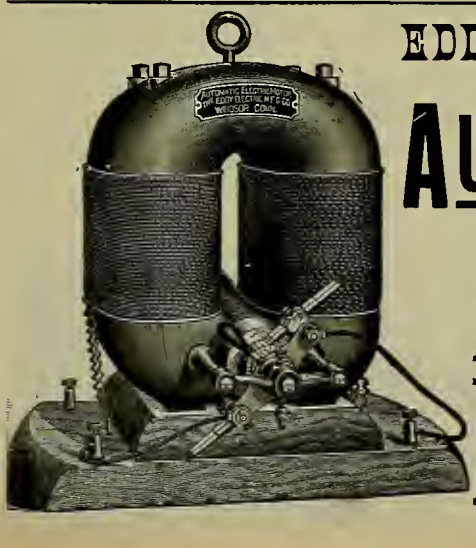

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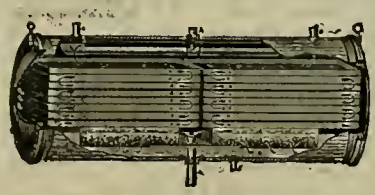

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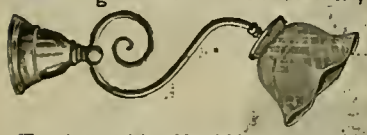

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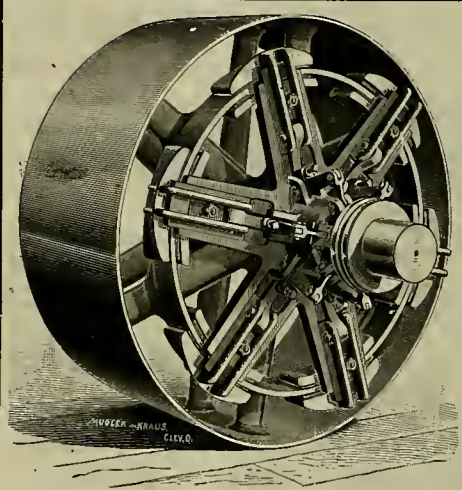

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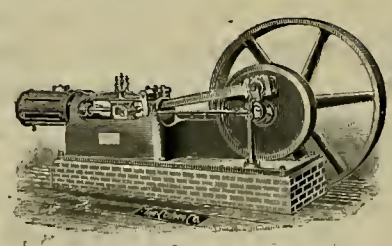

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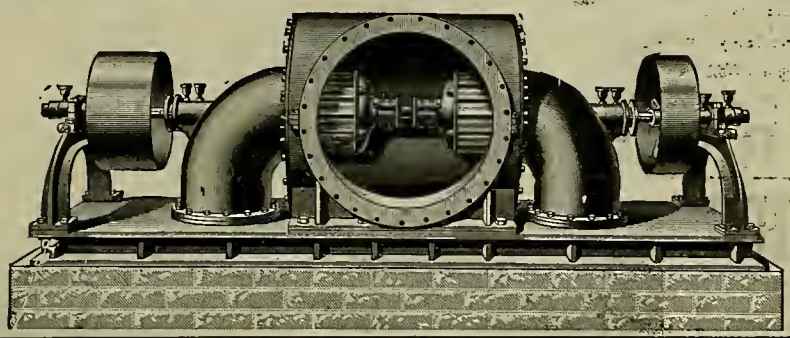

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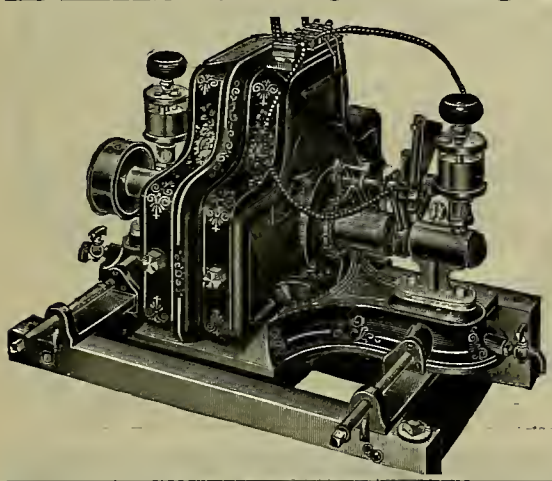

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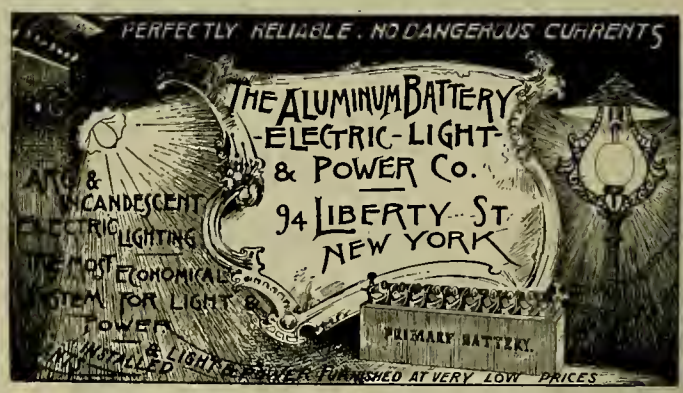

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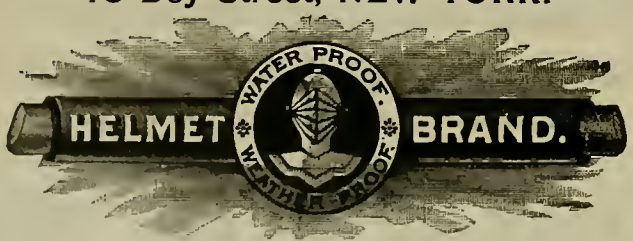

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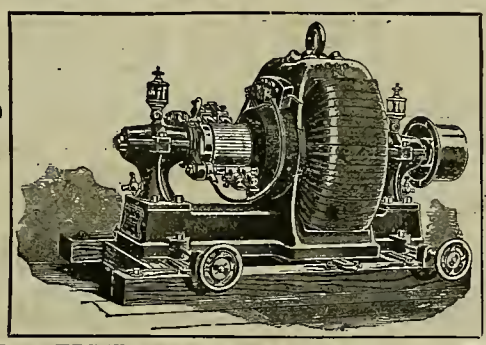

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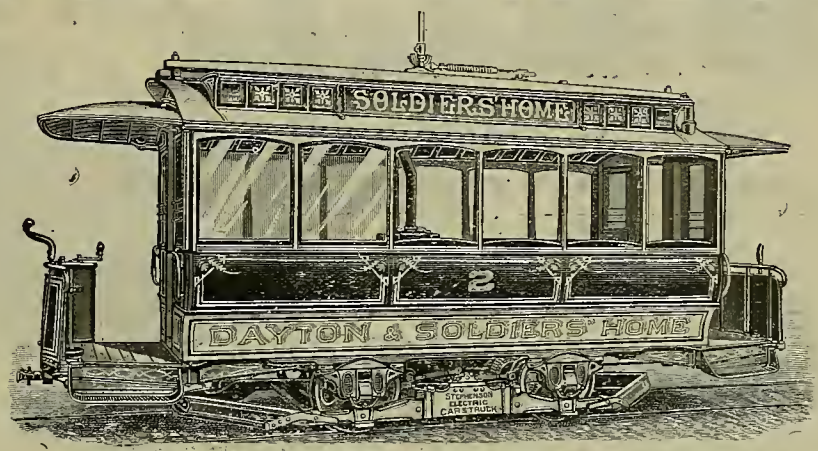

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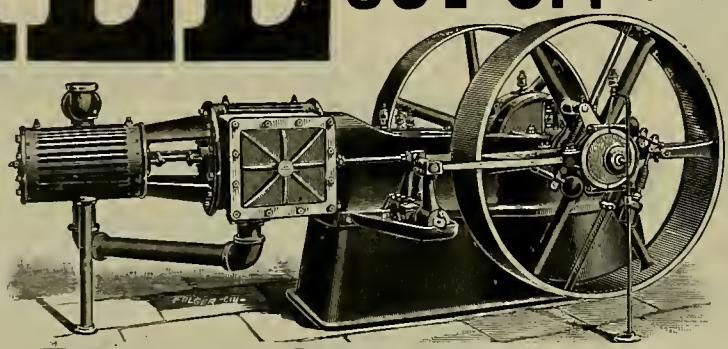

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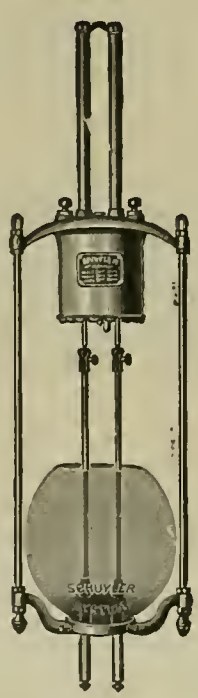

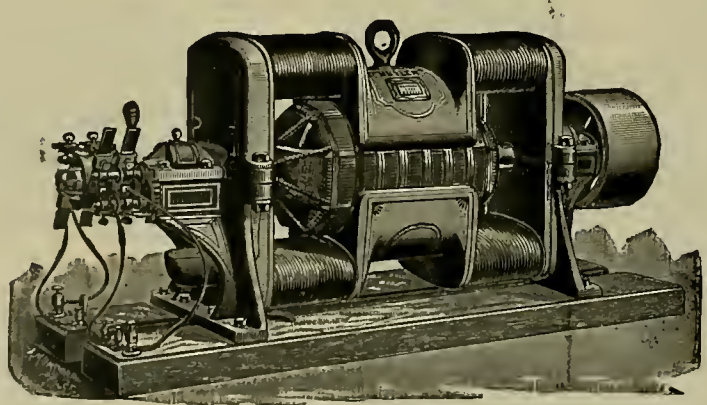

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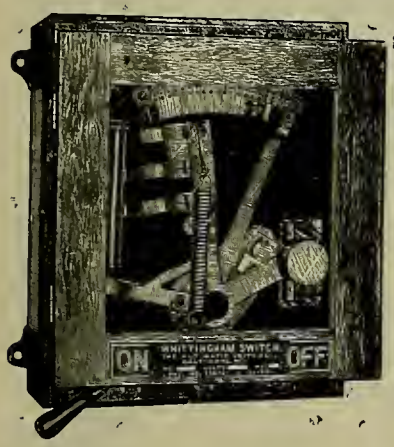

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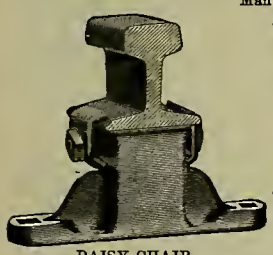

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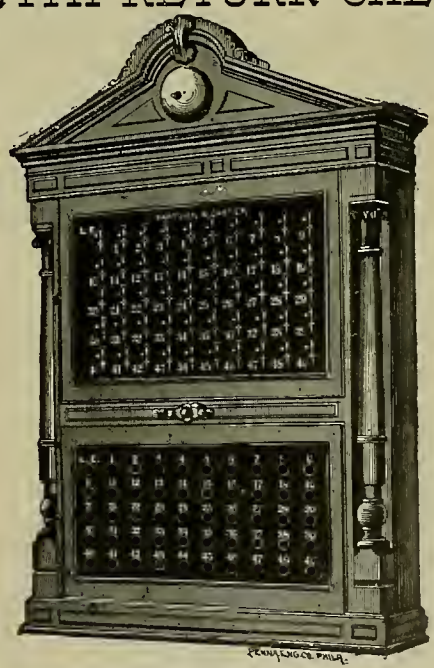

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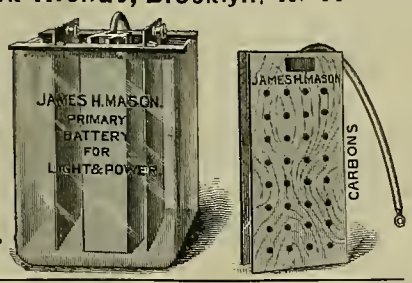

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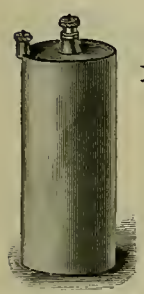

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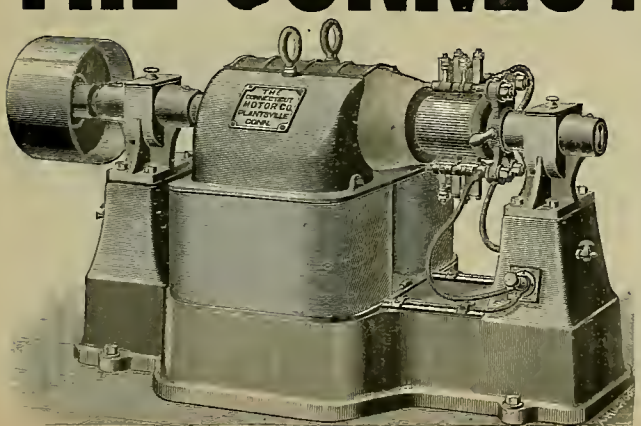

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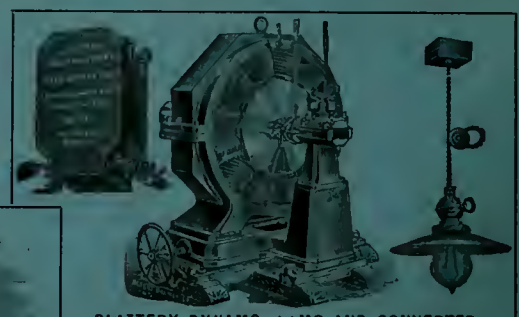

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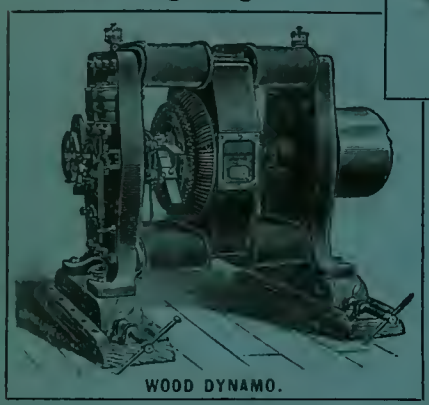

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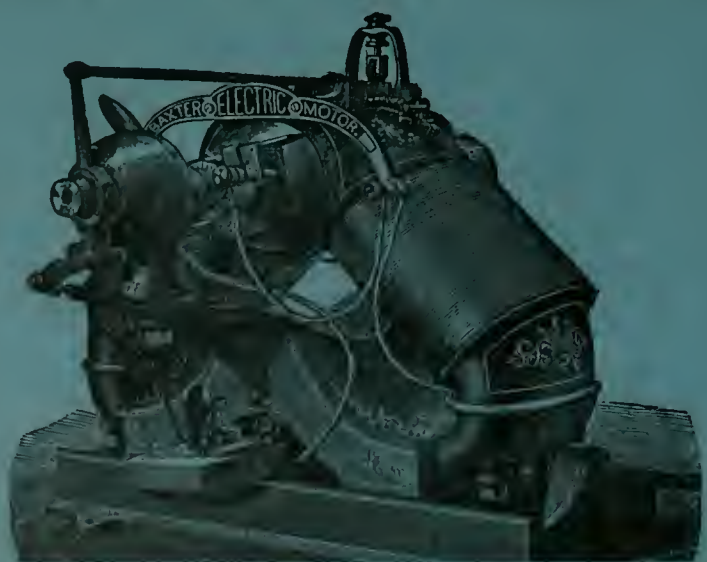

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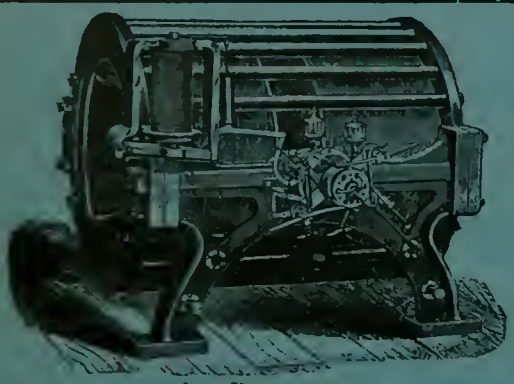

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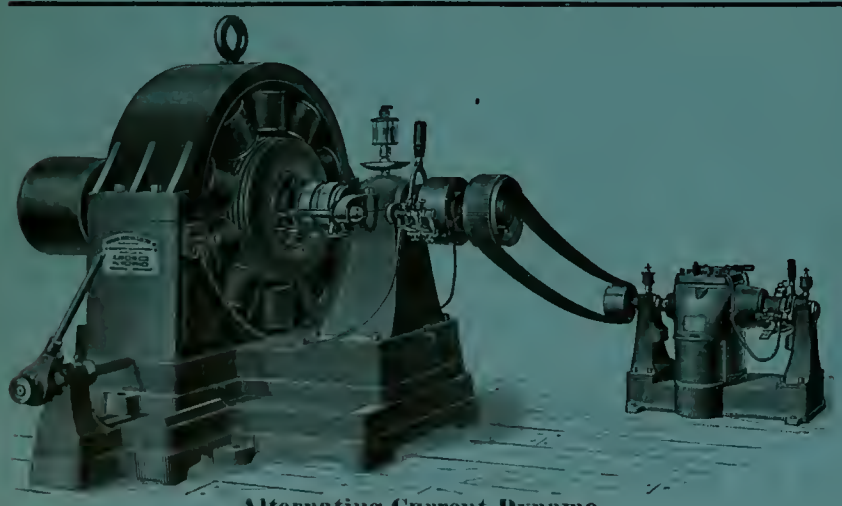

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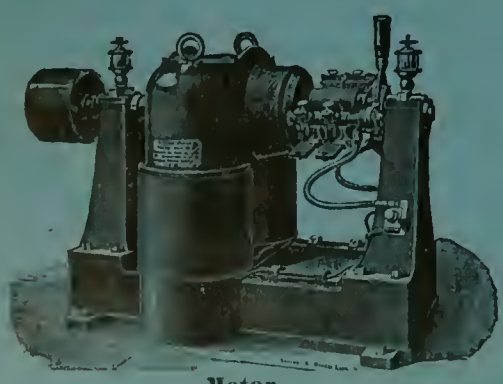

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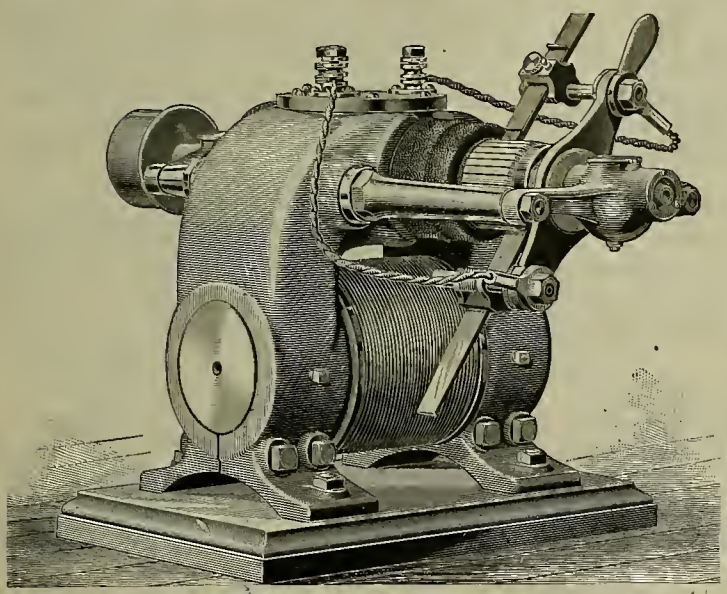

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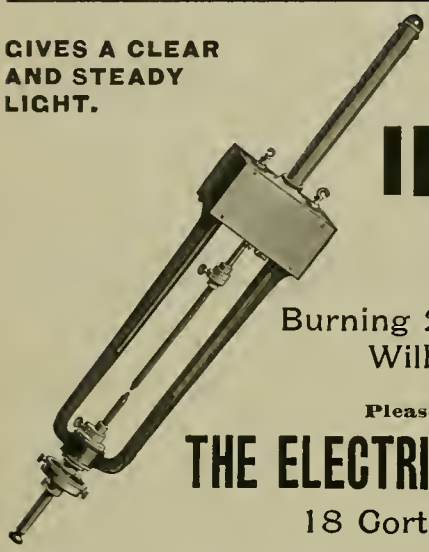

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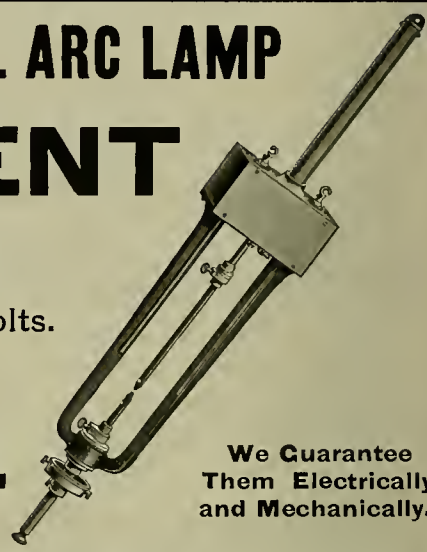

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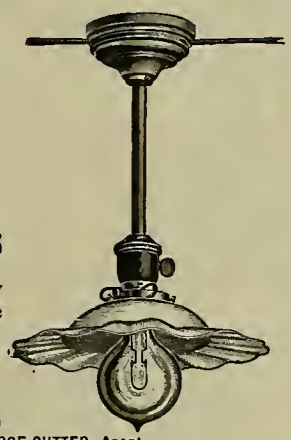

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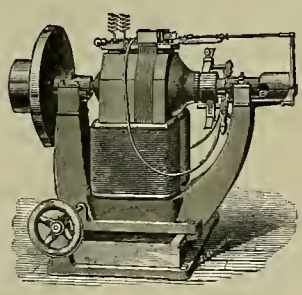

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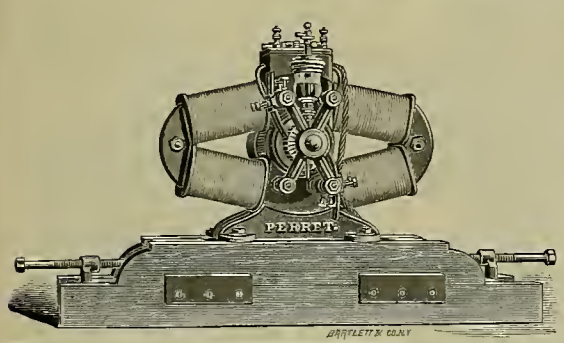

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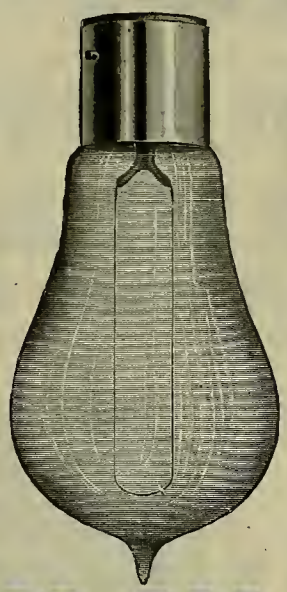

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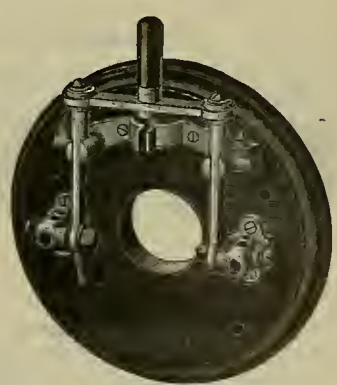

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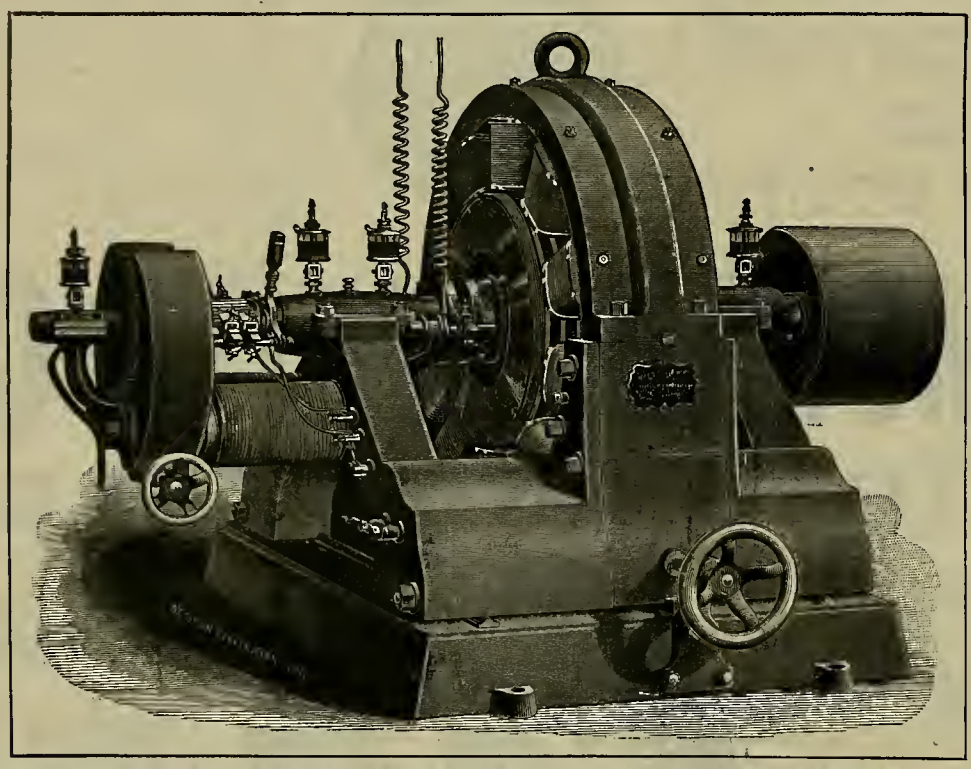

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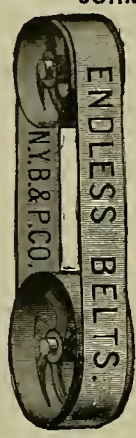

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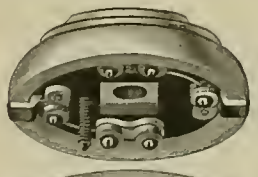

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Vol. VI. CHICAGO, MAY 3, 1890. No. 18

Rae Generator.

In the accompanying cuts is shown a Rae 65-000 watt generator manufactured by the Detroit Electrical works, Detroit, Mich. This dynamo is compounded for 500 volts at a speed of 850 revolutions per minute but it is so constructed that it will yield for a considerable length of time 23 per cent. beyond the nominal output. The field cores are cylindrical, and made of the softest wrought iron. The pole pieces and base are of the best cast iron. The shunt coils are of double covered wire wound on brass sleeves which are heavily insulated. These coils are constructed so that they may be easily slipped off the field cores. Immediately above and below the shunt coils are cut grooves on the pole pieces. These contain the series coils of insulated copper ribbon.

The armature is of very low resistance, and is wound with two layers of wire. It is of the drum type and the core is constructed of insulated disks of imported iron, in the following manner: The body is divided into sections, each of which is insulated from its neighbor by shellacked cheese cloth and built up of alternate disks of iron and paper. These iron disks are .006 or .007 of an inch in thickness. The whole is drawn together and clamped by means of washers and nuts, special precaution being taken to insulate the shaft and to secure the necessary driving pins which engage the wire.

The bearings of this dynamo are of the latest pattern, and oil throwing has been avoided by careful design. The connecting wires are colored black and are highly polished, and give the appearance of good workmanship and finish.

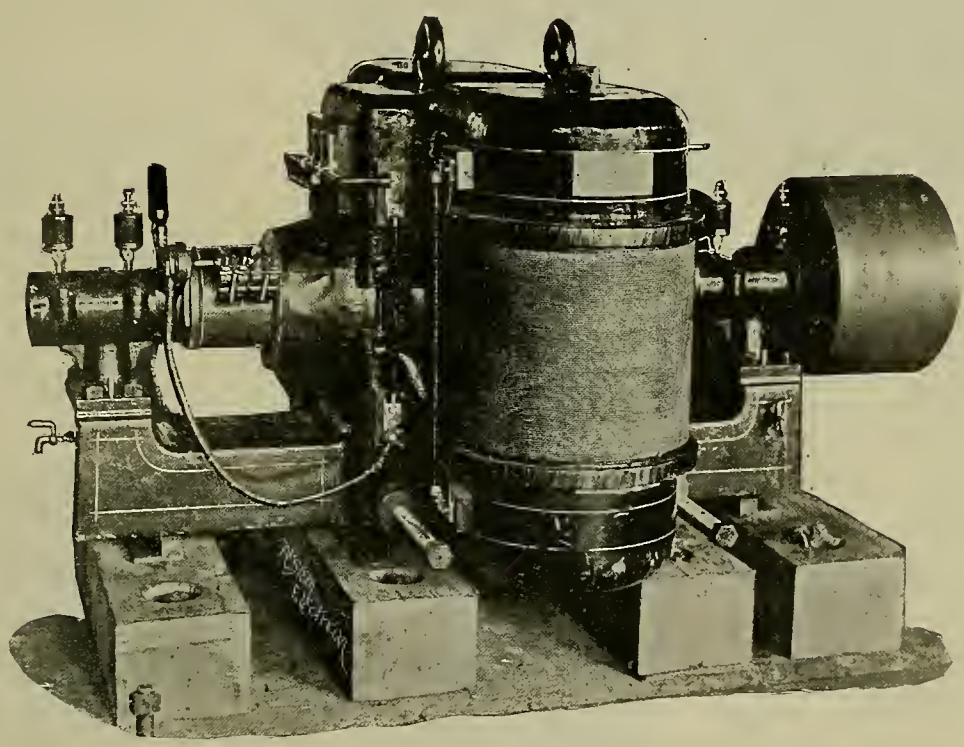


FIG. I. RAE GENERATOR.

Escape of Gas into Manholes.

Some idea of the amount of gas which escapes from the mains in New York City and makes the maintenance of an underground electric light service so difficult, may be gained from the following sketch of the testimony of Leonard F. Beckwith, chief engineer of the Consolidated Telegraph & Electrical Subway company, before the senate investigating committee. The gas that escaped, he said, naturally filled up the manholes, and formed a dangerous mixture with the air. The subway company had been trying to expel gas from the subways. This danger in New York was such a threatening one that a double set of covers was provided for each manhole. Mr. Beckwith said that in one city provided with subways and leaking gas a fire engine struck one of the caps of a manhole and at the same time a burning coal fell into the manhole. An explosion followed, which threw the fire engine over on its side. Mr. Beckwith estimated the gas leakage in the lower part of New York at about 20 per cent., and in the upper part of the city at about 12 per cent. This leakage, he thought, could be reduced to 3 or 4 per cent. In Paris wrought iron pipes wrapped with an asphalted covering were used, and the saving in leakgae paid for the extra expense of the pipes.

Underground Wires in St. Louis.

The Postal Telegraph company has asked permission of the city council of St. Louis to grant it a franchise for the construction of an underground system. This is the first telegraph company in that city to make an effort to bury its wires. The local manager of the company says: "I do not think that there is any opposition to the bill. If there is, it certainly does not come from the citizens, as they are now firmly in favor of putting the wires underground, both because of the unsightliness of the poles and on account of the greater safety of the underground system. We will use two 3-inch iron pipes, in each of which we will place a cable of about 25 wires. Our underground system will be about a mile long and will cost about $10,000. The wires will all be underground, the poles will be removed and the streets repaired within two months after the bill granting us permission to place our wires underground has been passed. We now have two main lines, but when we place the wires underground we will have only one. We do this to anticipate legislation in the matter, as it will not be long before it will be compulsory for telegraph companies to place their wires underground. All the other telegraph companies will follow the example set, and adopt the underground system. Of course it will be very expensive to make the change, but the running expenses afterward will be much less. Then the change will silence many complaints, and make it safer for us as well as the citizens. I think that the bill will pass the Municipal Assembly unchallenged."

Electric Lights and Rents.

It is astonishing the effect which the electric light has produced in rentals of buildings in the central portion of large cities. A great many of the handsomest restaurants in Chicago are now located in basements. Before electric lights were generally introduced the basements could not be used for this purpose to any great extent for the simple reason that no matter how may gas jets were used, the rooms were always more or less dingy. They could never be made attractive, and consequently it was not found a good investment to spend large sums in fitting them up. Within the last year or two in which rents have been enormously increased there seems to have been a general realization of the fact that by the aid of electric lights these basements could be made in every way suitable locations for many kinds of business. It is only necessary to walk through the principal business streets to ascertain how great a change has taken place in this respect. A large amount of valuable renting property has been brought into the market which formerly was used for little else than purposes of storage. Many of the largest and most profitable and most expensively arranged restaurants are located in basements.

Kemmler's Execution Postponed.

Murderer Kemmler, who was to have suffered the death penalty by the application of electricity during the week beginning April 27, was given a new lease of life on Tuesday last. Judge Wallace of the United States Court granted a writ of habeas corpus, which was served on Warden Durston of the Auburn prison, where the execution was to have taken place. A special dispatch to the WESTERN ELECTRICIAN states that the ground on which the writ was granted is the proposed use of a Westinghouse machine outside of the district for which patent license was granted to original owners. The writ is returnable in June, and Kemmler's execution is therefore postponed for a considerable number of weeks at least.

Muskegon, Mich., Electric Railway.

The directors of the Muskegon, Mich., Railway company have decided to extend the lines of the road to Lake Michigan, and operate the entire system by electricity. Five motor cars and trailers are operated on the road, and they have proven so successful that the company and citizens are thoroughly convinced of the advisability of extending the system. President Nims was instructed to purchase five additional motor cars and award the contract for the extension as soon as the preliminaries are arranged. Two new 200-horse power generators will be installed in the company's power house, and the contract for the equipment of the line and construction of the road will be awarded at once. President Nims says the company is very well satisfied with the change made from animal to electric power, and as soon as other sections of the city require street car service the lines will be extended if permission will be granted by the council.

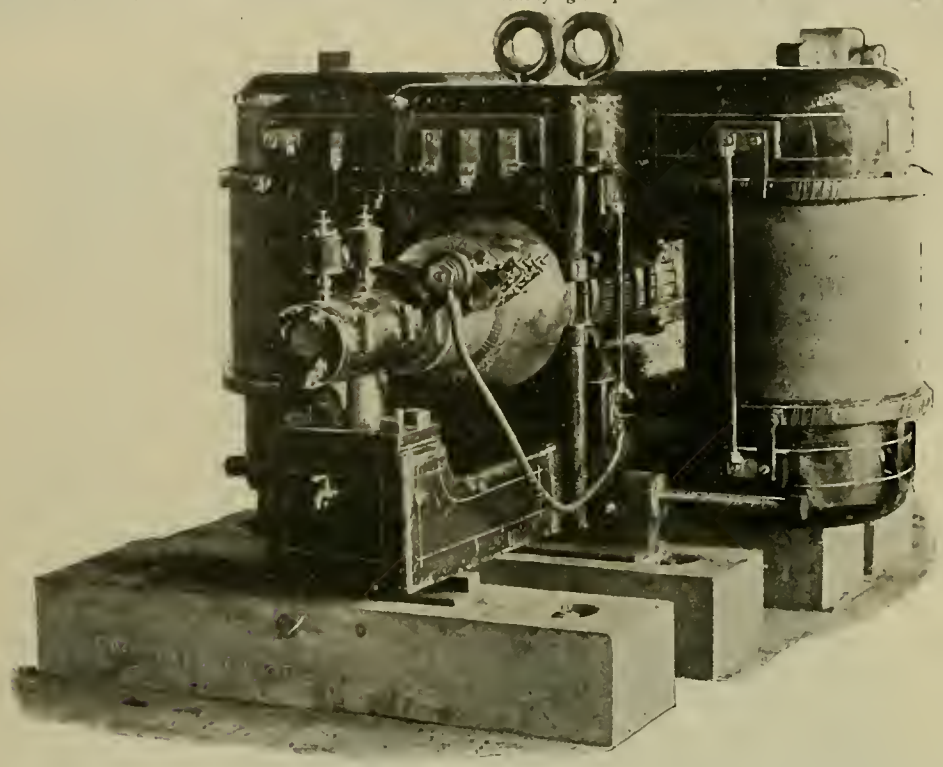


FIG. 2. RAE GENERATOR.

The Patton Motor Car.

The accompanying cut represents the Patton motor car which was built at the Pullman works, Chicago, and tested there last week. The company which controls the patents on this apparatus in Chicago and the vicinity has been experimenting with this car for three months. It is thoroughly satisfied with the test which was made last week. The car is 36 feet long and weighs 14,100 pounds. It is a double truck, 8 wheel car and the apparatus is in the center and arranged on the trucks so that the body of the car can be removed at any time.

The car is operated by a 15 horse power C. & C. motor, which is driven by a small Edison dynamo. This dynamo is belted direct to a double cylinder gas engine. There are also 55 cells of accumulators of the Pumpelly type. The motor is geared for 10 miles per hour.

It is claimed that this car can be operated at an expense of 11 cents per hour. The machinery occupies comparatively little space in the car, and requires scarcely any attention.

The test which was made last week was thorough in every respect. In addition to the regular car George M. Pullman had his vestibule car attached. This weighs 12,000 pounds. There were 37 persons in the party, and they were whirled about the curves at a rate of 10 miles an hour. In the party were George M. Pullman, Henry Villard, Marshall Field, Norman B. Ream, George F. Brown, T. F. Wickes, A. B. Pullman, C. L. Pullman and H. G. Bird. After the test an elaborate lunch was served by George M. Pullman, and the gentlemen who had witnessed the experiment expressed their belief that the car would prove a great success.

Contracts by Telephone.

The validity of contracts by telephone and the question of establishing the terms of the agreement were the subjects of a legal controversy in St. Louis last week. The opinion of Judge Valient on these points follows: "Contracts by telephone, when proven, are as binding as any other contracts, but the difficulty lies in the uncertainty of the proof, and this uncertainty is chiefly on the point of identifying the person with whom the witness held the telephonic conversation. When a message by telephone has been received there are many circumstances which may indicate who the person is that has spoken. But until some of these circumstances have been shown there is no proof as to who the person is. It has, for example, been held that the testimony of a witness to the effect that he was in the habit daily of having communications by telephone with a particular person, knew the number of the telephone in his office, and upon the occasion then in question had called up that number and recognized through the telephone the voice of the person, was evidence tending to prove the identity of the person who was in that case alleged to have made the contract. In the case at bar the defendant's testimony was to the effect merely that he called by telephone a number, asked who it was and the answer came back that it was the Paddock-Hawley Iron company; defendant then asked the price of iron delivered through the month of August, and the price which defendant claims as the contract price was given. There was no attempt by the defendant to identify the person with whom he held this conversation. Even if there had been no testimony to the contrary, this would not have been sufficient to justify the conclusion that it was the plaintiff. Whilst the ancient common law rules of evidence are broad enough in their philosophy to adopt the modern telephone and reduce it to service, yet the rules of evidence remain the same, and the principle that a party who alleges a contract ought to prove it with a reasonable degree of certainty, still applies. It has never been held, so far as I am aware, that a telephonic message merely purporting to come from a certain party, but with no other evidence of identification, was binding on such party."

PATTON MOTOR CAR.

The Book Table.

ELECTRICAL INFLUENCE MACHINES. By John Gray, B. Sc. 234 pp., 89 cuts. Published by D. Van Nostrand & Co., New York and London. Price $1.75.

As the author of this interesting volume remarks, static electricity has not received from investigators a fair amount of attention during the last few years. The explanation, of course, is easily found in the fact that the commercial application of dynamic electricity has required the attention of the vast majority of electrical workers. The author of "Electrical Influence Machines" believes that static electricity should receive more general attention for the reason that in the latest form of influence machines are found "generators of high tension electricity, both simple and convenient, less expensive than the induction coil and almost equally reliable." The book is clearly written, and is thoroughly illustrated. It is divided into three parts, comprising a general sketch of the phenomena and principles of static electricity, descriptions of influence machines and practical instructions for constructing them.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Vol. VI. Published by the Institute.

The present volume of over 500 pages comprises the verbatim proceedings of the Institute for the year ended Nov. 19, 1889. The year was a notable one in the history of the organization, and many papers of marked interest were presented. Appended to the proceedings are Secretary Pope's monthly bulletins containing indexes of periodic electrical literature, which are becoming of great value to every investigator in the electrical field.

DERIVATION OF PRACTICAL ELECTRICAL UNITS. By Lieut. F. B. Badt, and Prof. H. S. Carhart. 56 pp., 12 illustrations. Published by the ELECTRICIAN Publishing company, Chicago. Price, 75 cents.

This little book, in the main, is a reprint of two articles which originally appeared in the WESTERN ELECTRICIAN. Biographies and portraits of the eminent physicists whose names have been selected as the designations of the practical electrical units form the principal part of the little book. Information in regard to

the lives of these great scientists has been exceedingly difficult to secure heretofore, as those well realize who have searched encyclopedias. It is believed that in this little volume this information is made available for ready reference for the first time. Included in the book is a table giving the data of the practical units, and a chapter referring to the modifications to which the units are subject.

FIBER INSULATING CLEATS.

ELECTRIC TRANSMISSION OF ENERGY. By Gisbert Kapp 348 pp., 124 cuts. New York: D. Van Nostrand & Co. Price, $3.

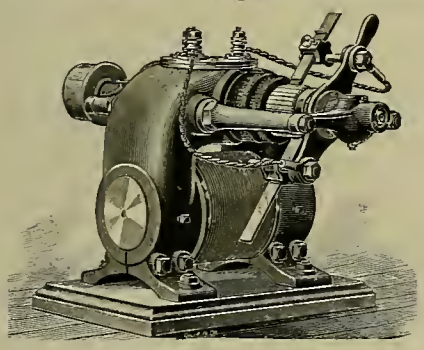
This is the second edition of Mr. Kapp's invaluable book. The volume has been somewhat extended since it was first published. The author's method for the pre-determination of the characteristics of dynamos has been incorporated in the book. Descriptions of obsolete machines have been omitted, and data of new dynamos are given. An interesting illustration of the wonderful progress which has been made in the field of transmitting power by electricity is given in the introductory chapter. Mr. Kapp states that he has omitted in the present edition particular mention of a large power station which had been referred to as a striking illustration in the previous edition. The reason for the omission is to be found in the simple fact that large installations for the transmission of power are now so common that the particular illustration which had been cited a few years before was no longer extraordinary.

Fiber Insulating Cleats.

The accompanying cuts illustrate a new form of insulating cleat which have been placed on the market by the Electrical Supply company of Chicago. These devices are neat, and as they are smaller than wood cleats, and therefore not so conspicuous, it is claimed they will prove extremely useful in many cases. The openings spring together so that the cleats may be fastened on before being put up, thus effecting a saving in time.

Jenney Electric Motor.

The accompanying cut illustrates a three-quarter horse power constant potential motor manufactured by the Jenney Electric Motor company of Indianapolis. This motor is uniform in design with the other motors made by this company. Among the advantages claimed for the Jenney motor by its inventor are the shape of pole pieces, and the method of connecting the wrought iron magnet core with the pole pieces. A practically perfect and uniform path is provided for the magnetic lines of force. There are no angles with their attendant loss of magnetism; and no imperfect joints with their unavoidable high resistance. Only one field magnet is employed, so that the magnetic circuit is very short. These features it is stated give a magnetic field of intense strength, which is at the same time very economical to maintain.



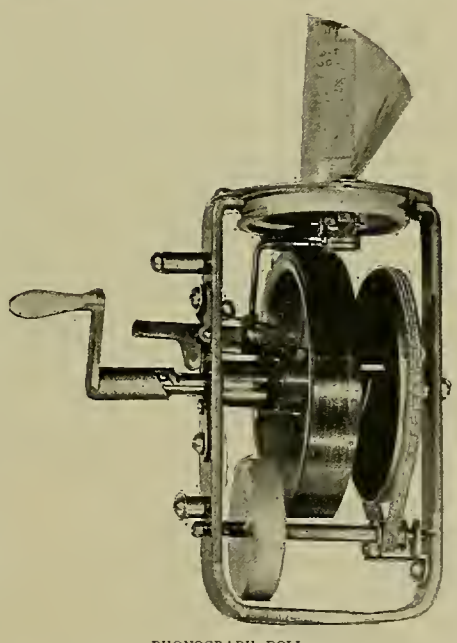
JENNEY ELECTRIC MOTOR.

A simple shunt winding is used; an automatic regulation of speed being secured without the use of compound winding, thus avoiding the danger of reversing when the motor is overloaded. Self-oiling bearings are used. The armature, which is of the Siemens type, is wound with the greatest care, and is thoroughly protected from injury. It is stated that the machine is so wound and proportioned that the neutral point remains fixed under the brushes, and there is no sparking at the commutator, even under extreme changes of load.

As an illustration of the durability of this motor, an example is cited of a machine that has been running day and night in Indianapolis for nine months, without a single item of repairs, and with no appreciable wear on commutator.

Phonograph Doll.

One of the most popular, if not the one of the most useful applications of the phonograph, is its use for rendering dolls capable of speech. The refinement of doll manufacture had practically reached its limit when the invention of the phonograph made its further perfection possible. Whatever may be the cause there is an irresistible attraction about a talking doll, even to those whose years warrant them in wearing a solemn visage. That little puppet in whose interior was stored the talking mechanism shown in the accompanying cut has awakened the interest of elders far more than it has excited the wonder of the young lady of four years who proudly claims it as her property. The doll, of which the speaking mechanism is here shown, was one of the first ever constructed by the Phonograph Toy company.



PHONOGRAPH DOLL.

The finished doll has substantially the same appearance as other dolls, but the upper part of its body is made of tin. The interior is filled with mechanism resembling that of the commercial phonograph, but much more simple. A close inspection of the cut will reveal the simplicity of the talking mechanism. The whole is most compactly arranged and when in place the ear piece extends up until its upper edge is flush with the surface of the doll's breast. The opening is closed with a perforated cover which is hidden within the loose folds of the doll's clothing. The cylinder of the phonograph of the talking doll is mounted on a sleeve which slides upon the shaft, the sleeve being screw-threaded so as to cause the cylinder to move lengthwise along the shaft. A trigger is provided by which the cylinder may be thrown out of engagement with the segmental nut, and a spiral spring is provided for returning the cylinder to the point of starting. The cylinder carries a ring of wax-like material, upon which is recorded the speech or song to be repeated by the doll. Upon the same shaft with the record cylinder there is a large pulley which carries a belt for driving the fly-wheel shaft at the lower part of the phonographic apparatus. The key for revolving the cylinder is fitted to the main shaft in such a manner that the cylinder can only be rotated in the one direction. The fly-wheel tends to maintain a uniform speed.

Above the record cylinder is arranged the diaphragm. To this is attached a reproducing stylus mounted on a lever in a similar manner to the one employed in a regular phonograph. By the simple operation of turning the crank any child can make the doll say "Mary had a little lamb," which it was taught to speak in the phonograph factory.

Alternating Current Armature with Iron Coils.

A new style of armature for alternating current dynamos, which possesses a number of novel features, has recently been invented by Prof. Elihu Thomson and M. J. Wightman of Lynn, Mass.

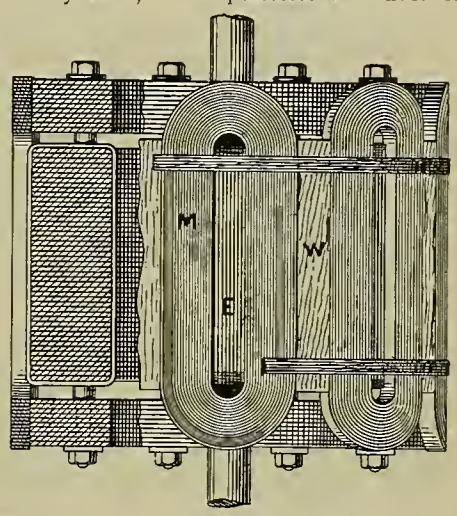


FIG. 1. ALTERNATING CURRENT ARMATURE WITH IRON COILS.

In this armature the coils generating the line current are composed of ribbons of sheet iron or any other similar magnetic metal. This departure in the use of iron generating coils in an alternating current machine, is alone sufficient to make the invention one of decided interest to dynamo builders.

Figs. 1 and 2 show the general construction of the armature. As will be readily seen, the body of the armature is supported on a spider carried by the shaft. The armature core is made up of plates or laminæ as usual, and these are fastened together by bolts, as indicated. Around the core at suitable distances apart are wound the coils *E*. These are the exciting coils for the field magnets of the machine. It will be noticed that they do not extend the full length of the armature, but pass through spaces left near each end of the armature, between the laminæ of the core. Around the exciting coils marked *E* on the exterior of the armature are wound the al-

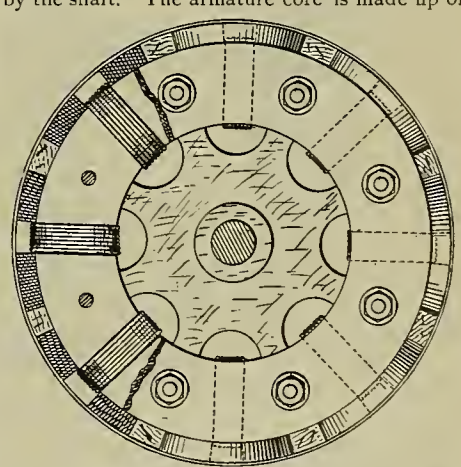


FIG. 2. ALTERNATING CURRENT ARMATURE WITH IRON COILS.

ternating current coils *M*. These coils are independent and are suitably connected together, so as to be in series, as usual, and are in electrical connection with a current-gatherer as ordinarily used in alternating machines. These last-named features, however, are not shown, in order to avoid confusion. Between the alternating coils are placed strips of wood, *W*. Bands are then placed about the armature to hold firmly in place the coils and wooden strips.

The alternating coils are suitably insulated from each other, and are composed of insulated ribbons of sheet-iron or any other magnetic metal instead of wire. The cross-section of the iron ribbons is made of such area as to render the conductivity of the ribbons the same as that of the ordinary copper wire used on armatures. For instance, the iron ribbon can be made three-quarters of an inch broad and three one-hundredths of an inch thick, which will equal the resistance of a No. 12 copper wire. These features will be readily understood after an inspection of Figs. 1 and 2. It will be noted by this arrangement that the alternating coils constitute the pole-pieces or cores, as well as coils or windings. It will also be evident that by this means the core of the armature is brought nearer to the pole-pieces of the field magnets, so as to increase the efficiency of the machine. This arrangement is, in fact, an armature of the Pacinotti type, and the alternating coils are arranged upon the exterior only, so that there is no dead resistance in the coils.

Sending Pictures by Telegraph.

In the WESTERN ELECTRICIAN of March 22d appeared an article describing a system of sending pictures by telegraph, which had been invented in England. The method consisted briefly of dividing into squares by ordinates and abscissæ, a sketch which it was desired to send by wire, thus forming a sort of chart. The squares were identified by letters arranged along the side of the chart. Each square was divided into five parts, which were identified by the figures 1, 2, 3, 4 and 5. Each of these subdivisions was divided into two portions, each of which was designated by the letter *j*. These divisions of the chart made it possible for a sending operator to explain to the distant receiving operator, who was provided with a chart ruled, lettered and numbered in same way, just how the picture might be platted. The several objects of the sketch could readily be located by referring to the letters and figures. In the article which was presented in the WESTERN ELECTRICIAN the method of sending a picture of Whitby harbor was illustrated.

The *Revue Internationale de L'Electricité* criticises this system quite severely. In the first place it questions whether by such a complicated system of platting, a picture which any one would recognize could be drawn. Further, it criticises the method for the reason that not only a long dispatch would be required to describe a mere outline, but that an extended additional message

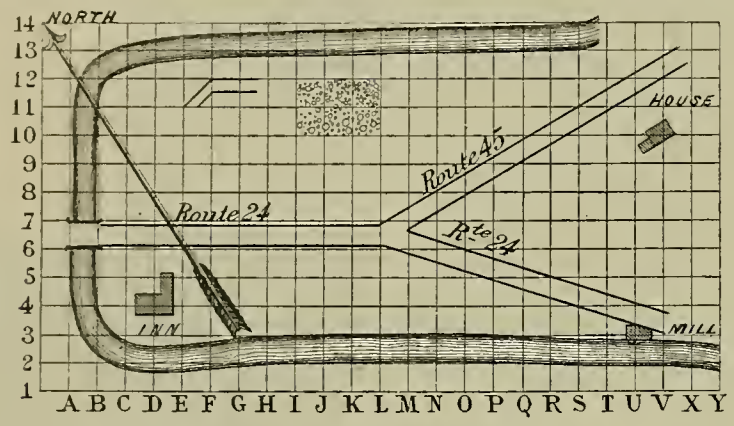


FIG. 1. SENDING PICTURES BY TELEGRAPH.

giving details for filling in a picture would be necessary.

The *Revue* also insinuates very strongly that the English inventor got his idea by visiting the pavilion of the French postal and telegraph department at the Paris exposition. The paper gives a description of a somewhat similar system which it thinks is much more simple and much more effective. This method of sending a sketch consists in tracing at the sending station an outline upon a sheet of paper ruled in squares, whose horizontal lines are designated by letters, and whose vertical lines are indicated by figures, Fig. 1. There are sent therefore to the receiving operator, who is provided with paper similarly ruled, as the data necessary for reproducing the picture, the numbers and letters of the lines which show the location of the objects in the picture. Now suppose it is desired to send a sketch similar to that shown in Fig. 1. The operator will telegraph as follows: North G 14—River 20m. V. A. 13—S. 13—Bridge 6 7—Route No. 24 6—7 L—V 3 4—Route No. 45 7 L—X 13—Wood I L 10 12—House 10 V—Mill 3 U—Inn 4 D.

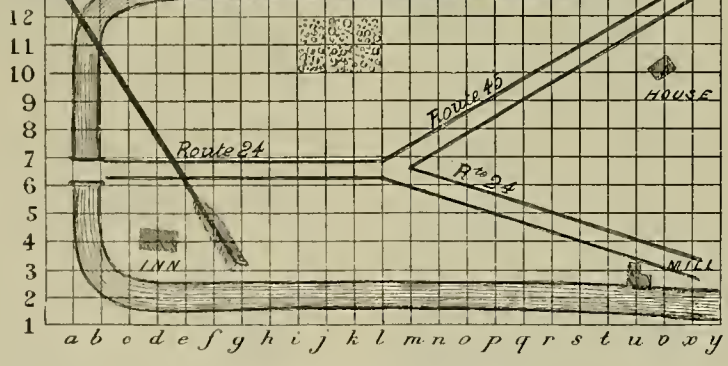


FIG. 2. SENDING PICTURES BY TELEGRAPH.

This telegram, equivalent to a dispatch of 25 words, can be written out and transmitted in five minutes. The receiver, guided by the indicated points, will produce the sketch in the same time, and the result of the operation will be approximately the outline shown in Fig. 2. The *Revue* thinks this system is much less involved than the English method, and therefore far superior to it.

We, however, fail to see anything in the French beyond a mere refinement of the other method. Such an improvement, we think, would naturally suggest itself to any one putting the system to a practical test.

Mayor Cregier and Municipal Control of Lighting and Power Plants.

BY MUNICIPAL.

Mayor Cregier, in his first message to the Chicago city council, advocated municipal control of light, and favored the establishment by the city of electric power plants. He says: "In my judgment the municipality should own, control and operate all works that produce that which is indispensable to its own and the general public necessities, and which could be furnished at little or nothing above cost. Chicago supplies her citizens with water. She provides channels of drainage. It is equally proper that the city should furnish her citizens with light for household purposes as well as public use." The mayor furthermore advocates municipal control of street railways, heat and power plants, and expresses his deep regret that lack of public funds will not permit him to inaugurate a policy almost fashioned after that which obtains in Russia.

It seems strange in this progressive age to find men advocating theories long since abandoned, returning to a policy inimical to all private enterprise and competition. It is essentially un-American. It removes all inducement to improvement, for under it there is no reason to fear competition. There can be no question as to the result of this policy. Wherever it has been attempted, it has resulted disastrously. The latest prominent example is found in the experience of Philadelphia in the management of the gas plants. There are many reasons why this experience will be repeated wherever a socialistic policy is adopted. Municipal control cannot be expected to succeed under the existing form of municipal government. Politics permeates every department of the public service, and political influence rather than personal merit secures appointment and advancement. This is not only true in Chicago, but in all large communities, and it is only to be wondered that there have not been even greater failures where it has been attempted. These failures have been only too frequent, however, to convince observing men that the whole system is radically wrong and utterly impracticable. Projects which under lively private competition would have developed, flourished and reflected credit upon the community, have been blasted by municipal control.

The same experience will follow an attempt to put into execution the comprehensive policy suggested by Mayor Cregier. If the city should conclude to go into the electric lighting business, it would be necessary to establish a new department. The operation of numerous electric light plants would entail the appointment of a small army of employes, and it is not to be expected the qualifications of applicants for positions would be considered very closely if they could command political support. This reflection suggests a train of thoughts to every taxpayer, and to all who are acquainted with "practical politics." It is easy to picture to the mind the service which might be expected from a system thus operated.

It may be objected that the experience of the city in establishing its street lighting plant does not warrant these statements, but it should be remembered that the present plant is comparatively small, and that its extension has been gradual. This has enabled the city electrician personally to superintend its development. The city has been fortunate in having at the head of this department a man of such sterling ability as Prof. Barrett. He, however, has not experienced the difficulty that would accompany the extension of the plant to the proportion required for supplying electric lighting to the general public. If such a project were seriously contemplated or attempted, he would be overwhelmed with applications from ward heelers, and would be subjected to political pressure which could not be disregarded by a person holding an office depending in a measure, at least, on political favor. This also leads to the question of practicability of the scheme for lighting houses as well as business blocks by

electricity. This is the proposition of the mayor, but it is hardly practicable at the present time. Chicago, it must be remembered, covers an immense territory, 176 square miles. This fact of itself would be enough to cause conservative men to hesitate.

If the city should establish power stations for the business districts at the public expense and furnish current at a price that would merely pay the expense of operating the plant, the small tax-payers in the suburbs would undoubtedly protest against being taxed for building these stations and purchasing the machinery. If the city in following the plan suggested by the mayor should extend the system so as to furnish electric lights to residents of Michigan avenue and other fashionable districts the small tax-payers would find in this discrimination another just cause to complain. They would not feel under obligation to build costly power houses in order that their wealthy fellow citizens might be favored with electric lights, when they themselves might not be in a position to avail themselves of the superior illuminant, even though the city's mains passed their doors.

It is unnecessary to consider the economic question involved in the proposition of the mayor. The fallacy of his argument is apparent. It is not considered good policy for any government to check private enterprise or subvert the public funds for the purpose of driving capital from a legitimate field of industry. On the contrary it has been the aim of American statesmen to encourage private enterprises, even to the extent of raising a barrier about them in the form of a tariff to protect them from foreign competition. Would the city be warranted in assuming control of the electric lighting industry? The Chicago companies, in common with all other electric lighting companies throughout the country, have been laboring for years to place themselves on a solid foundation, a paying basis. The men in charge of these plants are depending upon them, their money is invested there, and it is natural that they should conduct them on an economical system. Can it be expected that the city would operate its plants on the same economic principles? It is hardly probable when the employes know that their positions are secure only as long as the party to which they belong is dominant. Political hangers-on whose chief qualification is experience in handling Jersey lightning, are not generally considered desirable men for directing the affairs of legitimate business enterprises, nor does the peculiar training which they have experienced develop in them those traits of character which commend themselves to conservative men. Yet this is the school from which will be selected the "electricians" to whom the city will intrust this important industry if it be decided to adopt Mayor Cregier's suggestion.

Electric Launches.

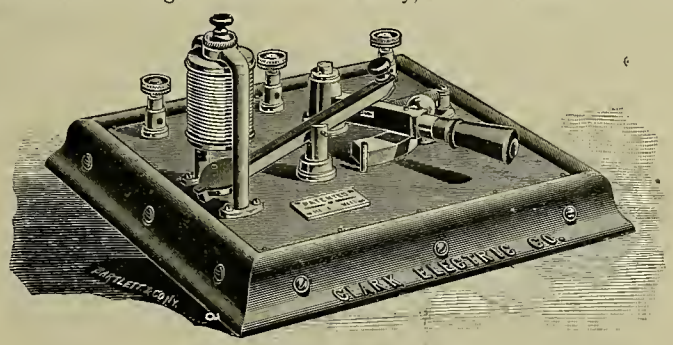
Electric launches for river use have become common, but now an electric launch, which is stated to have seagoing qualities, has been designed. The pinnace is 26 feet 6 inches by 5 feet 4 inches, and is constructed to carry fifteen people. The storage batteries with which she is supplied are computed to hold sufficient electrical energy to propel the boat for about eight hours at eight miles per hour without recharging A clear space is left the entire length of the boat, which is said to be free from danger, vibration and the disagreeable odor naturally associated with steam launches.

The Girard Gas & Electric company has been formed at Topeka, Kan., stock $25,000; directors, O. T. Broa, J. A. Bendure, of Pittsburg; J. T. Leonard, S. P. Christian, Austin Hawley, of Girard.

The Clark Automatic Safety Device.

The accompanying illustration represents a new form of automatic safety device, recently placed upon the market, by the Clark Electric company, of Brooklyn, N. Y.

The object of this device is to prevent accidents from fire or shock, or, damage to a dynamo, by putting the machine out of action the instant the line wire parts. The cut shows the apparatus as designed for series wound, arc machines. The small electro-magnet shown in the illustration is located in the main line and as long as the current flows, its armature lever is held firmly up, locking the switch in position. Should the line break the current ceases instantly, and the armature of the electro-magnet falls, releasing the switch, which flies back under the influence of its spring. The result of this movement of the switch is to short-circuit the field coils of the dynamo, thus depriving them of all current, and, of course, rendering the dynamo powerless.



CLARK AUTOMATIC SAFETY DEVICE.

The hard rubber knob at the top of the magnet is attached to a rod reaching through the magnet core, and is used as a convenient means of throwing the dynamo out of action at any time, it being only necessary to force the armature away from the magnet by pressing down the knob, to put the machine quickly out of action. Another feature claimed for the device is, that it works automatically every time the dynamo is stopped or put out of action, and it must be re-set by hand as the last thing to be done when starting the machine on its load. This in a measure insures its action when it is called upon, for should it get damaged or out of order the attention of the person in charge is called to it, as he must operate it every night in starting up.

The safety devices for shunt wound dynamos, and for alternators vary somewhat from the foregoing description in their electrical details, but the above will show the general plan on which all are constructed.

Incandescent and Gas Light.

The question, "Does a fine gas of 23 to 25-candle power help check the invasion of the incandescent electric light?" was one of the topics discussed at the last meeting of the Ohio Gas association. The question had been announced in advance and the members were primed for the debate. The general opinion was favorable to electric lighting. In the secretary's official report of the proceedings the following statement by C. H. Evans of Jackson, Mich., appears: "In my judgment the incandescent electric light has its field just as much as gas has, and there are people in certain manufacturing businesses perhaps, or offices, who would pay a larger price for incandescent electric light than they would for gas Some complain of the heat. Others say the electric light is preferable on account of its convenience —no matches, no danger of fire, touch a button and your light is ready, touch another one and your light is out. I know that in Jackson, in trying to win back a very large consumer of the incandescent electric company, they wouldn't have anything to do with gas whatsoever, because a few years ago they had a fire. It is a very large dry-goods store, with drapery goods largely, and a few years ago some lace happened to get into the gas flame and ignited, and the loss was some $35,000. They were willing to pay a larger sum for incandescent electric light, and in fact, refused to have anything to do with gas whatsoever. I think that condition exists more in large cities than in small cities. I don't think incandescent electric lighting is progressive in small cities at all. In fact, I think it is going down hill. But in larger cities, where they can afford to pay for the luxury and convenience of it, I think it is advancing. I know it is in Chicago, and I made a great many inquiries in that direction."

This is certainly a remarkable admission. Mr. Evans endeavored to soothe the members by the statement that he believed incandescent lighting was "going down hill" in small cities, but this is not corroborated by his own experience, evidently, if the instance he cites can be taken as a fair sample. Surely he cannot look on Jackson as such an enormous city.

Street Railway Pole.

The Milliken pole, for electric railways shown in the accompanying cut, is formed of four sections of iron of the Phœnix shape, riveted together with the tie plates, which are equidistant. Lacing is inserted at the point of greatest strain. A taper is given at the same point, as shown in the cut of the pole for the side of the street, Fig. 1, this construction giving the pole great strength for the weight of material used.

The pole was recently tested at Post & McCords Bridge Works in Brooklyn, and the pull at the top measured by a Fairbanks dynamometer. With a pull of 800 pounds the deflection was less than 4 inches. The deflection took place in a regular curve and showed no irregular bending. A block and tackle were then attached at the upper end of the pole and to the building and eight men pulled on the rope. Unfortunately the concrete was not quite dry and the pole moved bodily in the earth, the top being displaced about six feet toward the building, breaking the concrete up in lumps. When taken out of the ground the permanent set was so small that the pole was readily straightened in jaws.

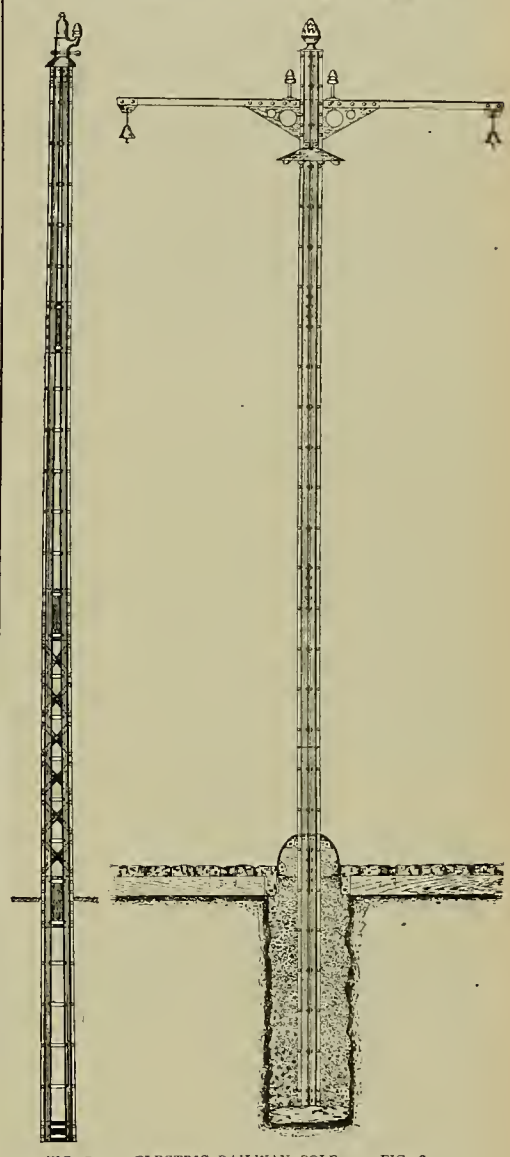


FIG. 1. ELECTRIC RAILWAY POLE. FIG. 2.

The center pole for use between the tracks, Fig. 2, has its longest diameter parallel with the rails. The cross-arms can be made separate from the pole if desired so for shipment, and bolted on after it is set in the ground. A cast iron bumper to keep wagon wheels from striking the pole is provided at the bottom. This is made in halves, bolted together on the inside, and can be filled with concrete as shown in the cut, if desired. The pole is sold by Lemuel W. Serrell, New York.

The new Thomson-Houston electric railway at Victoria, B. C., has been completed, and has proved so great a success that a considerable extension is under consideration.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE great activity among electrical inventors is again strikingly illustrated by our patent record this week. It will be noted that fifty-two letters patent for electrical inventions were issued April 22d. In what other field of industry is such activity manifested?

IT will be noticed by an article in another column that Judge Valient of St. Louis, has just decided a case involving the validity of contracts made by telephone. Although in the suit before them the judge found that the contract was invalid, the ground of the decision was that the agreement alleged to have been made was not proved; speaking generally, the court found that "contracts by telephone, when proven, are as binding as any other contracts."

MUNICIPAL control of gas and electric light plants has been thoroughly discussed, and it is generally conceeded by those best acquainted with the management of lighting plants that governmental interference in their operation would be highly injudicious. The recommendations of Mayor Cregier of Chicago, that the city should engage in commercial lighting were published last week and they are reviewed in an article published in this issue. In this connection it is also noteworthy that after examining the condition of affairs at Richmond and Philadelphia a committee from the Massachusetts legislature has found it "inadvisable" for the legislature to enact a law giving municipal control of lighting plants to cities and towns. This corroboration of the views advanced in the article printed elsewhere, is opportune. Mayor Cregier and the city of Chicago will find plenty to do in attending to the water and drainage questions which the mayor cites as precedents for engaging in the lighting business. It should be remembered in this connection that the control of these works by the city is granted as a sanitary measure rather than for economic reasons.

AN extract of a remarkably interesting address by Prof. Lodge is presented elsewhere in this issue. He points out the scientific fields which will abundantly repay exploration. What will strike the attention of every reader in perusing the address is the enthusiasm of its writer. Scientific research with Prof. Lodge is not laborious toil but a most absorbing and delightful occupation. The fields of investigation to which he points are certainly numerous enough to occupy the attention of scientific investigators probably for some centuries to come.

SOME months ago there was published in the WESTERN ELECTRICIAN a note to the effect that several dynamo builders on the other side of the water were looking about for a substitute for copper and were experimenting with iron with a view of adopting this metal instead of copper in the armatures of their machines. A patent recently granted to Elihu Thomson and M. J. Wightman would seem to indicate that American builders were not idle in this respect. In the patent referred to, the inventors describe an armature for an alternating current dynamo in which the generating coils are built up of ¾-inch iron ribbon about .03 of an inch thick, The iron ribbon of this size is to take the place of No. 12 copper wire. A description of the style of armature-core it is proposed to employ in connection with ribbon coils, is given in another column of this issue.

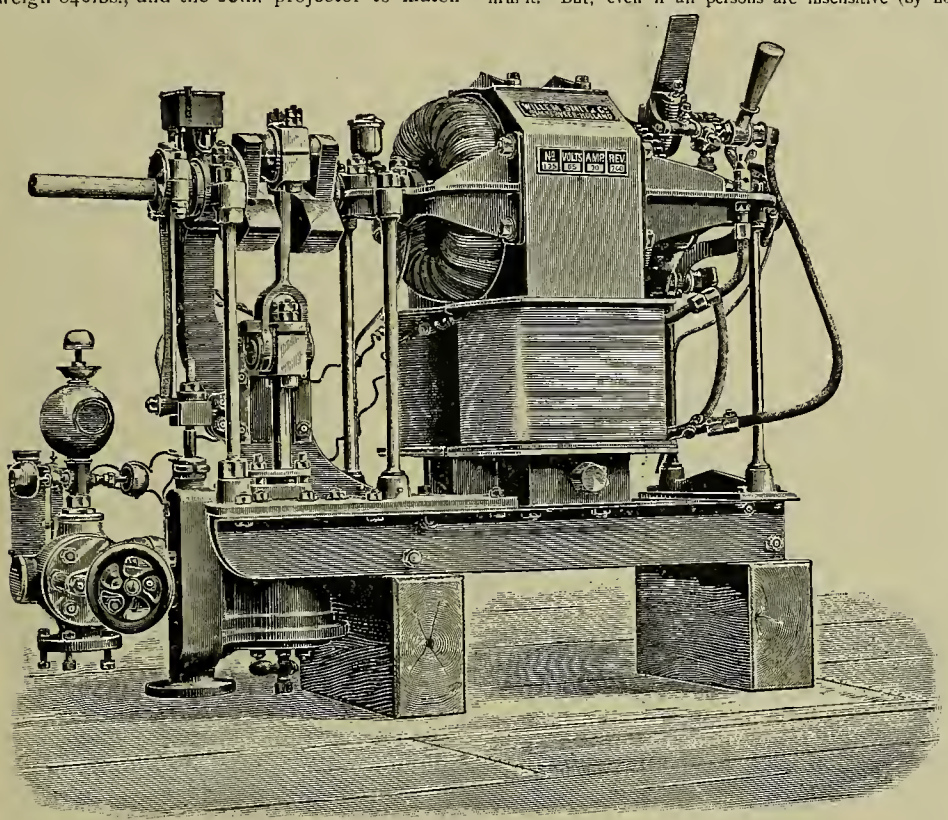
THE Boston letter of this week contains an abstract of an exceedingly interesting lecture which was recently given by F. M. Gilley at the Boston Institute of Technology. The lecture was on the "Central Electric Lighting Stations of London," and was illustrated by photographs taken by the lecturer while on a visit to London in the summer of 1889. Mr. Gilley mentioned among other things, that almost every English manufacturer of electrical machinery makes a number of different systems instead of confining himself to the exploiture of the system of a particular inventor. A great deal of experimental work, he says, is in consequence done in commercial stations, and as a result the successful completion of the plants is often retarded. He makes another statement, which in all probability would not be admitted by English electrical engineers, that is, that very few of their dynamos run cool. Motors, he says, are not used to any great extent and most elevators are run by hydraulic power from systems operating at 700 pounds' pressure. A 60 foot elevator is run by water at a cost of $36 per year, and with this the electric motor must compete. Referring to the English experts, or "engineers," as they express it on the other side of the water, Mr. Gilley stated that the height of their ambition was to superintend practical work without having first gone through the hard manual labor necessarily attendant upon the acquisition of thorough experience. Manual labor is deemed menial, he says, and the young men of the middle classes shun it.

IN the last issue of the WESTERN ELECTRICIAN was presented a somewhat detailed announcement of the organization of the Westinghouse Electric Railway company. Naturally, as a topic of general business interest, the formation of the company has been commented upon at considerable length in the daily press. The conjectures which have been printed have been almost without exception, erroneous. These are days in which much is said about the formation of a combination among electric light companies. The daily press has settled it, at all events, that practically a consolidation of the interests of two electric lighting corporations, each controlling an electric railway system, has been effected. At first the papers insinuated that a combination had been formed; then, as they found no one who would positively affirm or deny the rumor which they had circulated, they settled down to the firm conviction that such an arrangement had been formed. After this convenient disposition had been made the press found that the combination which it had formed was the inspiring cause of every important movement made in the electrical field. Thus it was that when the announcement of the organization of the new railway company was made, the correspondents at once jumped at the conclusion that between it and their combination there must be some connection. They have been sending dispatches accounting for the birth of the company on theories based on these inferences. What reasons were active in causing the formation of the railway corporation, if there were any beyond the ordinary one of money-making, are immaterial here. It is merely our purpose to emphasize the fact that the corporation was created entirely without regard to a trust or a semi-trust or combination. It was an independent creation. In regard to the reported combination little can be said for the simple and all-sufficient reason that those who are possessed of definite information have determined that it is the better part of wisdom not to disclose their plans at the present time. It is safe to venture this assertion, that the newspaper reports in regard to the matter, including the vague, indefinite and insinuating rumors, are certainly unreliable.

IN this issue Dr. Paul Schoop again treats of "A Theory of Accumulators." His original article on this subject, which appeared in the WESTERN ELECTRICIAN of March 8th, has attracted considerable attention. In that article Dr. Schoop devoted his attention mainly to combating the "sulphate theory," which he considered wholly inadequate to explain the operation of the storage battery. According to his view, the changes in the specific gravity of the electrolytic fluid are due, not to the formation and reduction of sulphate, but to the formation and decomposition of water during the charge and discharge of the cell. In his first paper, Dr. Schoop sought to explain the rise and fall of the specific gravity of the electrolyte by referring to the phenomena of the cathode; in the present article he considers the anode. The starting point is that there is such a thing as an "electrical compound"—a combination which is stable only under electrical pressure, so to speak. As an illustration he cites the Hermite bleaching solution in which the oxygen formed by the application of the electric current, is far more efficient for purposes of bleaching than that obtained by purely chemical means. Applying this idea, Dr. Schoop asks whether it is not reasonable to assume "that the oxygen of the black compound on the anode of a lead accumulator is in more effective position for exerting its power to develop electrical energy." Dr. Schoop emphasizes his belief that no chemical compound is formed on the discharged anode, but according to his view, a physical or electrical compound may be formed, which remains unchanged while in the electrolyte, but when removed and subjected to heat, it is converted into real sulphate of lead. Ordinary lead peroxide and electrically formed lead peroxide, though chemically the same, are by no means identical in these properties, says Dr. Schoop. Continuing, he says, in explanation of his theory, "There is certainly no reason for believing that the formation of electrical compounds is restricted solely to cases in which oxygen or gaseous elements are present. Fluids may be absorbed by solids similarly to the absorption of gaseous bodies, as observed by Faraday. The chocolate brown substances on the discharged anode may be a kind of physical compound of sulphuric acid and oxidized lead, which perhaps is only obtained by means of the electric current. A charged anode may remain in dilute sulphuric acid without change for almost an indefinite time. If external energy, say heat, is applied to this physical and at the same time electrical compound, a chemical action is effected, and the formation of real sulphate of lead, white and insoluble, takes place."

Dynamo and Engine for the Dutch Navy.

The combined engine and dynamo shown in the cut were designed for the Dutch Navy by Willem Smit & Co., of Slikkererveer, Holland. The combination was constructed for operating an arc light projector at sea. The dynamo has an output of 70 amperes at 65 volts. The armature is Gramme wound with 3.5mm. wire. The speed is 450 revolutions per minute, and is controlled by an electro magnetic governor interposed in the shunt circuit. An effort has been made to reduce the weight of the machine as far as possible in accordance with the demands of the Dutch naval authorities. It is possible that this reduction in weight has been carried too far and may affect the efficiency and durability of the engine. The engine has 4in. cylinder, by 5in. stroke, and works with 100lb. to 150lb. pressure of steam. The engine and dynamo together weigh 840lbs., and the 20in. projector to match



DYNAMO FOR THE DUTCH NAVY.

weighs 520lbs., or 1,360lbs. total weight. The outside dimensions are 3ft. 9in. long, 2ft. 6in. high, and 1ft. 5½ in. broad.

Fields for Scientific Research.

At the annual meeting of the Physical Society of Liverpool, Prof. Oliver Lodge in his presidential address spoke of the scientific fields which physicists would find it of great interest to explore. Following is an abstract of the address:

Running over some of these open paths we come across a fruitful field in a study of the effects of light on a great number of things. That light affected chemical combinations has long been known, and it is the foundation of photography, but we now find there is scarcely anything which light does not affect. It affects selenium enormously, bringing down its electrical resistance to half or one-third what it is in the dark; it may affect other bodies in a similar way. It affects metals, charging them electrically in a curious way, especially such metals as zinc. It seems to disintegrate or evaporate surfaces long exposed to it. It affects the electric field, causing a short spark to occur much more easily in ultra-violet light than in the dark. And quite recently, by Shelford Bidwell, it has been found to affect the magnetism of an iron rod in a sensitive condition. Of none of these phenomena has the investigation more than begun. Then, in the region of photography, there is a good deal to be done, not only in understanding the photographic process itself, but in photographing rays hitherto intractable. The photography of ultra-red rays a good way below the visible spectrum is, so far as I know, in the hands of Captain Abney, who discovered how to do it. But others should now take it up and develop it. Celestial photography, with plates sensitive to obscure rays, might reveal a number of unsuspected and invisible semi-cool worlds. The electric spark has lately been a favorite subject for photography, and much good work may be done by obtaining judicious photographs of lightning on fixed and on moving plates. A double-nozzled camera, with two plates, one fixed, the other spinning rapidly on an axis perpendicular to its plane (kept spinning at an approximately slow speed, say by clockwork), so that the same flash is depicted on both plates simultaneously, would give much valuable information. For some flashes a very moderate speed of rotation, or even a wiggling camera, suffices, but for others a speed of 30 revolutions a second gives an image apparently the same as if the plate were still. What is known as the Hall effect in various substances has not yet been exhaustively observed or measured. It has not even been observed as yet in insulators, though it ought, one would think, to be there; nor has its connection with the Faraday effect, the rotation of the plane of polarization of light by magnetism, been at all satisfactorily or finally made out; while its discrimination from, or assimilation to, certain known thermo-electric facts is at present hanging in suspense. Perhaps, however, these matters are rather too complex to be suitable for mention under present circumstances.

A simpler and more qualitative research is the effect of magnetism on a number of things. For instance, on living organisms. A person in a magnetic field is not known to feel anything. Reichenbach thought he had found people who were optically sensitive to a magnet, so that they could see whether an electro-magnet is excited or not. It may be so, but subsequent observation has not gone to confirm it. But, even if all persons are insensitive (by no means a likely conclusion without experimental proof), other animals may not be. Phosphorescent things—a glow-worm, or some of the luminous sea beasts of Dr. Herdman—may be fit subjects for experiment. How, again, does a gymnotus or electric eel behave in a powerful magnetic field? I can imagine a fine field for a physicist to encamp on Puffin Island, under the auspices of the Biological society, and bully some of the microscopic and other animals with electric and magnetic and optical appliances. Even if they declined to take any notice, the fact ought to be ascertained; but if any of them were properly sensitive, development of the fact might be surprising. Then, again, plants; sensitive and other muscular plants are well known to set up electric currents and to be under electric control; magnetism might be applied to plants also; and about their electric phenomena there is much more to work out. Heaps of experiments on plants and on germinating seeds could be made by an ingenious physical experimenter, and, though they might be more sluggish in their response than animals, some remarkable development might ensue. A change of physical surroundings in the course of a few generations might bring about noteworthy changes of structure. Seeds growing under inverted circumstances as regards light have, I suppose, already been experimented on. I do not know. I am not familiar with the subject, and the biological suggestions I throw out are therefore vague. But this I feel, that so long as the origin of life is wrapped in mystery, experiments on the simplest form of protoplasm—subjecting it to a variety of kinds of circumstances, electrical, magnetic, optical, thermal, mechanical, and chemical—may any day, though not perhaps for a few centuries yet, result in an astounding discovery, which will throw our present idea of evolution into the shade.

A number of experiments and observations can also be made on crystals and crystal formations by those who have suitable opportunities. The accidental formation of twin crystals, and the beautiful optical phenomena which develop themselves at the twinning surface, are matters of quite recent discovery, or, at least, of recent attention. So also is the perfectly astounding fact that a crystal, such as Iceland spar, for instance, can be mechanically twinned or pushed over into its perverted form by the pressure of a knife judiciously applied. Effects of magnetism on chemical action have now been discovered, and it is known that a piece of magnetized iron is less easily attacked by an acid than ordinary iron, provided, at least, the iron is pointed so that its lines of force are very diverging, or its field rapidly varying. But many other facts remain to be ascertained in connection with these subjects. The electrical properties of flame are only partially worked out, and their power of discharging static electrification has had fresh light thrown on it quite lately by some experiments of Worthington. The study of phosphorescent substances is yet in its infancy. Why should not a phosphorescent substance give out a really useful amount of light? What is the process by which the glowworm maintains so brilliant a speck of illumination?

Many amateurs possess an induction coil, having, indeed, often made it themselves. Approximately the same number of amateurs do not know what to do with it when made. They use it to illuminate vacuum tubes, which they buy at a shop, nicely colored. Well, don't buy them, but make them, and omit the colors. Read the researches of Mr. Crookes, and other more recent investigations on the subject by Schuster, and Moulton, and Wiedemann, and others, and you will find in the electrical phenomena of high vacuum an unlimited field for profitable experiment. More than this: A whole continent of practically unexplored territory has just been opened by the discovery of Hertz that electro-magnetic waves in air can be easily produced and detected. Some may know and some may not know of these brilliant investigations into the propagation of electro-magnetic waves. But any one with an induction coil, an empty room, and some bits of metal can repeat many of them. And repetition of known experiments is the natural prelude to the discovery of new ones. The Hertzian receiver is a microscopic spark gap. This serves, but it is by no means necessarily the best, as it is certainly not the most metrical method. Gregory has tried a kind of metallic thermometer with some success. In Germany, I hear a kind of bolometer or wire resistance thermometer has been successfully used. Quite lately, Fitzgerald writes me that a galvanometer in circuit with a simple wire makes these waves apparent. This will simplify their investigation very much. That is always the way. Once a thing has been done, hundreds of ways of doing it turn up. For instance, the telephone. The transmission of speech by electricity seemed a mighty achievement, and so it was; but now, almost anything will transmit speech—a flower-pot full of cinders has been made to talk. The great electro-magnetic waves excited by any kind of electric discharge are now under easy control, and they can be reflected by mirrors, refracted by prisms, concentrated by lenses. They can be polarized and analyzed. Diffraction and interference effect can be detected in them. Everything optical has its counterpart in this new region, for they are to all intents and purposes light: as Clerk Maxwell predicted nearly a quarter of a century ago, from refined and abstract mathematical investigation.

The whole of this great field now lies open to the explorer, and only a few have entered it. Here and there a mathematician, here and there an experimentalist, is at work upon it, but there is plenty of room, and every fact is of interest. These electric waves have been obtained as long as 2,000 miles and as short as a foot; they can easily be lengthened, they cannot so easily be shortened. If shortened to the 10,000th of an inch they would affect the retina and be visible. At present they belong to the region of the infra-red. Whether they affect the human frame at all is unknown. Apparently they do not, but further experience may show that they do.

A Theory of Accumulators.

By Dr. Paul Schoop.

"A Theory of Accumulators," which the writer advanced in a paper bearing that title, at the Chicago Electric club, March 3d, has been subjected to a certain amount of criticism. After reading some of these criticisms I came to the conclusion that the statements which I made at that time were perhaps not sufficiently clear. The theory of the action of the accumulator is one of such great interest that I have determined, even at the risk of repeating some of the statements made in the paper, to consider the theory from a somewhat different standpoint. I noticed in the London *Electrical Review* of April 11th that a part of my paper was reproduced. Prof. Carhart's criticism of my theory was printed by this paper somewhat more completely. It seems to me that he overlooked the essential facts stated in the paper, which tell so strongly against the "sulphate theory." My suggestion, which is not new, as I have already stated, was the outgrowth of a realization of the fact that it is utterly impossible to explain the working of a lead accumulator on the theory of the formation of known chemical compounds. Even the critical professor seems to have been convinced that the old theory can not stand much longer. Although during the discussion which took place after the reading of my paper, he put himself on record as a firm believer in the "sulphate theory," still a fortnight later in his remarks (see Western Electrician, March 22d), he finds that "the reactions in a storage battery are undoubtedly very complex."

Subsequent to the appearance of this article of Prof. Carhart's, I corrected an erroneous

statement of the specific gravity of the acid, which had led my critic to the most important of his strictures. Certainly additional experiments are needed to make these "complex reactions" comprehensible.

The views as advanced by me in regard to the lead accumulator had reference principally to the kathode or the negative plate, leaving out of the question the reactions at the anode. I now desire to deal with the latter electrode and consider *electro-chemical* or *electrical reactions* in general. It may be confidently assumed that no chemical compounds now known to the science of chemistry are formed on either the kathode or the anode of a good accumulator. It is also true that the formation of water during the combustion of hydrogen on the kathode does not alter the specific gravity according to experimental observation made to determine the fact. Perhaps it is possible to account for the rise and fall of the specific gravity of the dilute acid by considering more closely the anode. In endeavoring to do this, I desire, first, to speak generally. The term chemical-compound is an extensive expression. It has been difficult for chemists ever since their science has been thoroughly established, to find a proper definition of the term chemical-compound. The popular explanation has been that a body unites with another by reason of a certain chemical reaction, if the *atoms* come into proper relations, either by penetrating into the foreign molecule, or by their rearrangement in the same molecule.

The intensity of chemical attraction between bodies has often been measured by the amount of heat or light set free during the period of combination. The greater the amount of heat developed, the greater ordinarily the stability of the resulting compound, or in other words, the more difficult to separate the components of the compound. This stability varies in such a way that perhaps no two compounds have exactly the same stability. There are bodies which resist every effort to decompose them, as, for instance, what we call elements to-day. Other bodies are unchanged by the highest temperature, while others disintegrate as the result of even a slow rise of temperature. Some compounds are stable when under a high pressure and low temperature; they are resolved at once into their constituent elements under normal conditions. There are many reactions in which no heat at all is evolved during the combining period. The resulting compounds often contain the original substances almost unaltered in their properties, if, indeed, it is proper in such a case to speak of chemical combination at all. Take for example, many alloys of metals, solutions of salts, acids and other bodies in fluids, and gases absorbed by porous solids. In such cases where a particular action upon the atoms cannot be predicated, it has been asserted that a mere *physical combination* takes place, or that an attraction of the *molecules* was effected, while the atomic forces were left unaltered. No displacement of atoms is supposed to have been effected. It is by no means uncommon that a combination of two substances may be produced if they are not liable to react upon each other by mere contact, by applying a form of energy from the outside, by heating a mixture, for example. Often the addition of a third substance is effective in causing a change, although it apparently remains quite unaltered during the combining process. Recall for example Faraday's researches on the power of platinum to produce a combination of gaseous bodies.

Electricity is a powerful agent in effecting combinations, although chemistry, as a matter of fact, has utilized it more for the purpose of separating compounds into their constituent elements.

It has been observed that two substances which will unite as a result of mere contact will form a different compound if they combine during the application of an electric current. The Hermite electric-bleaching process may be cited as an illustration in point. There are compounds which can be obtained only by the use of an electric current, and probably there are still other compounds which are stable only under electric pressure, so to speak, and which decompose the instant that pressure is removed. May not such compounds play an important part in the lead accumulator, at least on the anode?

The great practical importance of a solution of this question may lead to an investigation of what we may call "*electrical compounds.*" One illustration may be mentioned: If bleaching powder is dissolved in water, a solution is formed which having strong oxidizing qualities, destroys organic colors. It has been ascertained that the efficiency of bleaching powder depends entirely upon the amount of active oxygen contained in the solution, and this amount can be determined very exactly by chemical means. After having used such a solution for bleaching a definite quantity of cotton, it will be found that its useful power has disappeared. Active oxygen is no longer present. It has been calculated that one pound of active oxygen in the bleaching powder solution can whiten about one hundred pounds of cotton. Hermite took the solution which had been used and which had been deprived of its oxidizing quality by the work that had been already performed, and passed through it an electric current, using two platinum electrodes. The water was decomposed and while the hydrogen escaped in bubbles in the water no escape of oxygen could be detected. The solution had absorbed the oxygen. After current had been passing a certain time just the amount of active oxygen is added to the solution that it possessed originally before it had been used. This fact may be demonstrated by chemical analysis. We take now one hundred pounds of raw cotton and bleach it with the new electrically treated solution as before, and we see that a change has been effected in its character. Bleaching is effected by its use in one-third the time and the solution whitens not one hundred pounds but one hundred and fifty pounds of cotton and yet the electrically treated solution contains no more active oxygen than before. The only explanation of this interesting fact is that the electrically developed oxygen or the electrically-formed compound (although chemically the same as the bleaching powder) is still different from it and contains its oxygen in a "more active form" than the pure chemical compound. The Hermite bleaching compound therefore, may be regarded as an electrical compound, in distinction from the bleaching powder obtained by purely chemical means. But what do we mean by "a more active form" of oxygen? Would it not be better to say that the oxygen in the electrically formed compound is in a better condition to exert its bleaching energy than in the chemical bleaching compound?

Now let us apply this idea to the action of the storage battery. Is it not apparent that the oxygen of the black compound on the anode of a lead accumulator is in a more effective position for exerting its power to develop electrical energy? The most oxidized lead known to chemistry, viz., the ordinary lead peroxide or anhydrous plumbic acid, has a lower potential in contact with dilute sulphuric acid than the electrically formed lead peroxide. The two bodies are not identical in characteristics. There is certainly no reason for believing that the formation of electrical compounds is restricted solely to cases in which oxygen or gaseous elements are present. Fluids may be absorbed by solids similarly to the absorption of gaseous bodies, as observed by Faraday. For example, sulphuric acid or a part of its molecule may be absorbed by the anode during the discharge of a lead accumulator. The chocolate-brown substance on the discharged anode may be a kind of physical compound of sulphuric acid and oxidized lead, which perhaps is only obtained by means of the electric current. A charged anode may remain in dilute sulphuric acid without change, for almost an indefinite period. If exterior energy, say heat, is applied to this physical, and at the same time, electrical compound, a chemical reaction is effected, and the formation of real chemical white sulphate of lead takes place. As soon as that result takes place the accumulator is utterly unfit to take up current, to use the common expression. Now to make a general application: If two bodies come into juxtaposition each exercises an influence on the other and each atom undergoes a change, just as a number of magnetic needles show different effects if a permanent steel magnet is brought near them. Each needle deflects in accordance with the distance, the relative position of the magnetic lines, the mass of the magnet and the mass of the needle, the surrounding gas, etc. Now bring the magnet close to the needle and a mechanical adhesion of the two takes place. The force of gravity seems to be suspended. In a similar manner the situation of the atoms in the molecular combination is altered, if there is any change in the environments of the molecule. If the influence of the reaction is sufficiently great another molecular combination will be effected, and if the disturbance is more powerful a displacement and a new grouping of atoms will be formed. An electric current affords the most interesting and easiest method of acting upon molecules and atoms without changing their environments. We must believe that there are as many new compounds or combinations formed by applying electricity as there have been effected by adding water, for instance.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 26.—In spite of the hard blows that electricity is receiving at the hands of municipal and legislative bodies, its promoters feel content that it will survive the storm and that it will eventually reap great profits from the system now being established. The agitation of the senate committee has stirred up Mayor Grant to a renewed interest and the meeting of the Board of Electrical Control gave him an opportunity to fire a little hot shot at Expert Wheeler, who had prepared a report regarding the effect of heat on the underground wires in Broadway. In his report Dr. Wheeler stated that a practicable cable must necessarily be affected by heat from its proximity to steam pipes. Upon referring to reports of electrical experts the mayor directed that a new report be made, based on personal knowledge regardless of the aid of any electric lighting company. The ridiculous investigation of the senate committee has called out the following comment from the *Sun:* "The General Laws Committee of the State Senate have come to town and will take testimony to-day as to the effect of escaping gas and steam in the streets. If any of the members of the committee are doubtful as to the effect of escaping steam, they can meet at Fifth Avenue and Twenty third street, or some other convenient place and wait for a manhole to blow up. There is no doubt that the subterranean steam of New York is able and numerous so to speak. As to the effect of escaping gas, we sincerely hope that none of the committeemen from the happy agricultural regions blew out his gas last night."

The Metro-politan Museum of Art is closed, pending the placing electric lights, the arrangement of which has been carefully studied out by General di Cesnola and his assistants and is sure to enhance the beauty of the great paintings.

The representatives of various electric light companies which made bids for lighting the city say they could not make anything at the price they offered, and that even at an advance of four cents a lamp a night New York would be paying a less rate than any other large city. The city apparently proposes to hold to a return to gas light, and electric light men claim that they will be the gainers at the prices named in their bids. In the event of a new deal the city will be compelled to make even a better offer and pay in proportion to prices received in other large cities.

The most conspicuous among the decorations of the Crescent Athletic club entertainment at the Brooklyn Academy of Music was a mammoth crescent formed of electric arc lights, occupying the middle of the proscenium arch.

Mrs. Olive E. Friend, her mother, Mrs. Emily Howard, George A. Halstead and Orrin Halstead, who have been confined in the Tombs for alleged participation in the electric sugar swindles, have been released on their own recognizances. The indictments will be held over the accused, however. The leader of the gang, "Parson" William E. Howard, is in Sing Sing prison serving a ten years' sentence, his trial and conviction having occurred in June of last year. Prof. Henry C. Friend, who originated the swindle, died before justice could overtake him.

In the State Legislature the committee on electricity reported adversely on Mr. Clarke's bill regulating telephone charges, also adversely on Mr. Sullivan's bill relating to the Electrical Subway company of New York. W. H. T.

Leavenworth, Kan.

LEAVENWORTH, Kan., April 26.—J. A. Bovard of Kansas City, Mo., was in the city last week. After a few minutes' consultation with the mayor, he left the city greatly dissatisfied, if not thoroughly disgusted, with the interview, the object being to obtain certain rights on Third

street as to the construction of the new electric line, which was denied him. The Leavenworth *Times* says: "Now comes J. A. Bovard with his associates to buy the dummy line, over which the residents of Third street have been instituting suits against and claiming in each case enormous damages, when, in fact, the line is a blessing to them as well as to the city at large. In this purchase, this gentleman proposes to replace the steam motor with the noiseless electric motor, and has about completed all the details of the purchase, and had even gone so far as to arrange for his power, as Mr. Walker will leave for a day or two to purchase new machinery for the Light & Heating company with the view of selling the old Scott plant and machinery to J. A. Bovard, from which he would furnish the power for his new electric line. All these schemes have been thwarted by the unofficial acts of this official, who should either die or resign at once, as he has virtually driven men, manufactories and money from us, and should be personally accountable for such acts."

The Leavenworth Street Railway company proposes to turn its line into an improved electric railway, and will extend its line as far west as Twentieth street and as far southwest as the new driving park and fair grounds; and ultimately it proposes to extend the line northward to the fort, and southward to the Soldiers' Home. H.

Topeka, Kan.

TOPEKA, Kan., April 26.—There were over 200 couples in attendance last week at Metropolitan hall, where the first annual ball of the conductors and motormeers of the Rapid Transit railway was given. When the guests were ready to go home, there were electric cars waiting in front of the hall to speed them to any part of the city. It is expected that the ball will net the men $400, which will go toward paying for new uniforms.

The Rapid Transit Railway company determined some time ago to light its trail cars by electricity, as well as the motor cars; and although there were many obstacles in the way, it has succeeded in obtaining the best results. Last week a train was made up with lighted trailers, and President Bartholomew and the other officers of the road proceeded to Oakland, to put the new system to the severest test, and all were greatly pleased with the results. The company will at once equip all other trail cars and motor cars with this system, and the darkness which was so striking by contrast last year in the trail cars will be a thing of the past. The Rapid Transit company is pushing work to the full capacity in the repair and paint shops, and will soon have all cars repainted and varnished.

The Brush Electric Light & Power company received a letter last week from a number of merchants, stating that, as their stores were closed each evening at 6:30, except Saturday nights, and the evenings of the Atchison, Topeka & Santa Fe railroad shop's pay days of each month, they thought the price should be reduced in proportion to the time the lamps were needed. The Brush company replied that a reduction was out of the question.

Judge D. C. Metsker of the Central Electric Light & Power company of Topeka, and of the Sedalia, Mo., Electric Railway, Light & Power company, announces that he will be a candidate for the Republican congressional nomination in the Fourth Kansas district, to succeed Harrison Kelley. F.

Louisville, Ky.

LOUISVILLE, Ky., April 26.—John Bartman, member of the General Assembly from this city, has introduced a bill to incorporate the Louisville Conduit & Subway company. The incorporators are Charles F. Johnson, Dennis Long, and W. B. Holdeman, of this city.

At the general council meeting a few nights ago the Ohio Valley Telephone company's bill for the month's service was reported for approval, but Alderman Davis objected to it. The amount was $159. He said the city used more telephones than it needed and wanted an investigation. The matter was referred to the finance committee.

In speaking of the matter, Capt. Gifford, of the Telephone company, said: "The city has about thirty telephones for which it pays about $159 a month. The rate is a reduced one and is, in fact, just about enough to pay for the expense. There is no money in it. We charge $5 per month for single wire telephones and $4.50 a month for each telephone in the Fire and Police Departments. The amount charged is not more than the expense of hiring a bookkeeper. The rate charged regular subscribers is $6 a month. The twenty-three telephones in the Fire and Police Departments cost $103.50, and the other eleven about $55."

T. B. Byrnes, expert electrician of Evansville, Ind., has gone to Frankfort by request of a special committee of the General assembly to make an estimate of the cost of installing an electric light plant for the Frankfort penitentiary.

Gov. Buckner has vetoed the bill amending the charter of the Newport, Ky., Electric Light company. The reason assigned was that the provisions of the original charter were amply generous to the company, and that the proposed amendment sought to enlarge its privileges to a degree detrimental to the public.

Harrodsburg, Ky., or at least the main business portion of it, was almost wiped out by fire April 21st. The Western Union telegraph office was burned, the telephone exchange was almost ruined, and nearly all wires were down or hopelessly entangled. Telegraph and telephone connection to outside points were entirely cut off for a time, and the Electric Light company's wires, which had hardly been put into good working order, were all down on Main and Poplar streets.

The state senate has granted the Louisville Gas company the privilege of electric lighting, and at the same time has amended its charter, withdrawing its exclusive privilege to make and sell fuel gas. This action settles all the differences between the Louisville Gas company, the Louisville Electric Light company and the Natural Rock Gas company.

On account of the alleged successful tests of electric headlights on railroad engines, the L. & N. and other local railroad lines are said to be seriously considering the question of using electric headlights on their locomotives. A trial will be made here shortly.

The electric light plant for the Western Kentucky Lunatic Asylum, at Hopkinsville, was put in successful operation on the 16th. L.

Cincinnati, O.

CINCINNATI, April 24.—The Birmingham, Ala., city and county officials recently visited Cincinnati to inspect the different systems of electric railways in operation here. They left very favorably impressed with electric roads and say they will soon dispense with dummies and horses in Birmingham.

The Bradford Belting company intends to operate its large factory with electric motors exclusively.

The telephone exchange, corner of Hunt street and Broadway, was burned out recently to the extent of $5,000 as a result of the carelessness of linemen dropping wires on the Electric Railway company's wires.

Work has commenced on the extension of the Colerain avenue route of the Cincinnati Street Railway company, and the motor cars will be running from Fountain square to Cumminsville by June 1. The Thomson-Houston system is used.

Electric light work is practically at a standstill here at present, owing to the consolidation of the different companies About forty linemen have been laid off temporarily.

The Cincinnati, Covington & Newport company expect to start its cars about May 1 with Short electric motors. M.

Pittsburg, Pa.

PITTSBURG, April 26.—Two of the most extensive street car systems in the country have lately changed hands, and both have become the property of Pittsburg capitalists. This is certainly an evident proof, that the people in this city have a great deal of confidence in the future of the street railway business as an enterprise worthy of investment. The first deal comprises the purchase of the Cream City passenger railway of Milwaukee. The transaction was concluded the other day for the consideration of $900,000, which the Pittsburg syndicate paid for everything possessed by the corporation. The Cream City passenger railway is 23 miles in length, and it is considered the most comprehensive system in Milwaukee. The road is considered extraordinarily cheap, and compared with other sales of a recent date, it is at least worth between $2,000,000 and $3,000,000. The Pittsburg capitalists are: John W. Chalfant, A. M. Byers, A. W. Mellon, W. L. Van Kirk and John Moorhead. The other deal represents the purchase of the entire street railway system of Louisville, Ky., which has been acquired by the syndicate composed of H. Sellers McKee, Murray Verner and E. H. Clark of Drexel, Morgan & Co., Philadelphia. The price paid for the latter is said to have been $1,200,000. Both roads are to be operated by electricity, but what systems are to be adopted has not been decided yet.

The Westinghouse Electric company has received the contract for furnishing the entire electric equipment for a street car company in Lansing, Mich. The street railway department of the Pittsburg company is now in operation at its full capacity, and the motors and other railroad machinery are turned out day and night.

Some of the firemen employed at the power house of the Pleasant Valley electric street car line in this city have gone on a strike, because they were not satisfied with the amount of wages they were getting. They wanted $2.00 instead of $1.63. The company, however, refused to listen to the demands of the men, and they left their work last Sunday morning. The company has since secured new men, and the operation of the line was not the least interfered with.

The works of the Washington Carbon company at Washington, Pa., are being considerably enlarged, and the capacity of the works will be correspondingly increased. It is expected to have the largest portion of the plant under roof by the 1st of June, giving the concern an opportunity of manufacturing daily from 50,000 to 60,000 carbon points.

The Westinghouse Electric company has issued a comparative statement of its sales for the first quarter of 1889 and 1890, showing an increase of 80 per cent. The figures are as follows: 1890, $1,111,970.41; 1889, $621,336.92.

Wilkinsburg, a suburb of Pittsburg, is to be connected with this city by an electric railroad. Work was commenced a few days ago of laying the tracks, and the company expects to have the road running by next fall.

The cable and electric roads in this city are about to have sprinklers connected to their cars. This movement has been the result of some tall kicking, in which the citizens have indulged latterly, on account of the dust which is constantly created by the running of the cars.

The Squirrel Hill Electric Railroad company of this city is perhaps one of the most unfortunate corporations which ever embarked in the electric railway business The company was chartered about two years ago. For a considerable time it had to contend against strong opposition in councils to get the necessary ordinances passed. At last, however, owing to the energy and enterprise of the promoters of the road, they overcame all opposition, and a short time ago they were allowed to go ahead and build their line. But apparently that did not seem to end their trouble, because one of the contractors has just sued the company for $6,000. The result has been that an execution has been issued against the company, and the local papers printed the announcement the other day that the road is to be sold. H.

Kansas City, Mo.

KANSAS CITY, Mo., April 24.—A syndicate of Kansas City, Boston and New Haven capitalists, including the Thomson Houston Electric company, have purchased the entire plant of the Joplin, Mo., Electric Light & Power company, and proposes at once to enlarge the plant and expend at least $100,000 in improvements. This purchase also includes the water power obtained from Grand Falls on Shoal creek, from which the Electric Light and Power company received its power, and eighteen acres of land surrounding the falls. The syndicate will at once begin improvements by constructing a large electric light and power plant, by which it will be enabled to increase the lighting service of the city. Arrangements will also be made to put in new machinery for furnishing power to the mining companies for running their jigs, rolls and crushers and everything else that can be operated by electric motive power. The syndicate proposes not only to take care of all present demands, but anticipate a large increase in the mining and manufacturing business of Joplin. Over 3,000 horse power can be obtained directly from Grand Falls, and this can be increased by the construction of flumes. The long proposed construction of an electric street railway in Joplin is a part of the general scheme, and as soon as affairs are settled this will be taken under consideration. The price paid for this plant and the Grand Falls power is $55,000. The Kansas City gentlemen in the syndicate are E. L. Martin, A. E. Stilwell and M. C. Curtis. E. P. Merwin of New Haven, Conn., is representing the stockholders of that city.

The Kansas City and Independence Railway company, of which mention was made last week, was organized about four years ago, W. J. Smith and Robert Gillham being at the head of the enterprise. The capital stock of the company is $100,000. It is the plan of the company now to increase the capital stock to $400,000, and as soon as the bonds can be placed to build a first-class double track electric road from the western terminus of the Independence avenue line by the most direct line practicable, to Independence. It is the intention of the company to build an electric power house about the middle of the line, which will be not far from the Blue river.

The last preliminary step toward the construction of the Kansas City and Blue Valley electric road, was also taken last week. The stockholders voted to increase the company's capital stock from $50,000 to $75,000, and to issue new bonds to the amount of $75,000. The road will be built by W. B. Knight, contractor, and will be finished from the present terminus of the Fifteenth street cable line to Centropolis by August 1st, or at the latest by Septem-

ber 1st. It will be an electric line. It will be operated in connection with the Fifteenth street cable line. It is only a matter of a very short time until this line is extended to Washington Park and finally to Independence.

The electric roads with their cheap construction and operation will soon thoroughly thread the eastern part of the city and suburbs, and the southern suburbs will not be far behind, if any. An influx of subscriptions in the past week has insured the immediate building of the suburban electric line on Troost avenue, south to Brush creek and west on Springfield to Grand avenue. The Ivanhoe Park company, now operating an electric line on Vine street from Eighteenth street to Brush creek, is only waiting further developments in the new suburb of Albion, near the Blue, southeast of the city, to extend a branch line east, and as there is no possible doubt as to the completion of this residence suburb according to the plans originally proposed by the company, the extension is practically a certainty.

There are other street railroad schemes among the plans of moneyed men and practical street railway men, enough to show that Kansas City suburbs will soon be as accessible by rapid transit as are now the more central points.

W. B. Grimes, who is erecting a handsome office building on Main near Eighth street, has contracted with the Thomson-Houston Electric company of Boston, through C. S. Rusling, its local agent, and Fairbanks, Morse & Co., special agents for the motor and elevator department for a fast electrical passenger elevator. This will be the handsomest elevator yet placed in this city.

Interest in the proposed West Side electric line in Kansas City, Kan., has been revived, and there appears to be some likelihood of the line being constructed this season. Two prominent eastern capitalists, Messrs. Guernsey and Shearmen, are in the city inspecting the route with a view to taking hold of the enterprise, if satisfactory arrangements can be made with the members of the company.

The route of the proposed line is along Third street from Minnesota avenue north to Lafayette avenue, thence west along Lafayette avenue to the Quindaro boulevard, and along the boulevard to Quindaro.

Norton Thayer of the Thayer & Enright company that secured a franchise from the Kansas City, Kan., council some weeks ago to construct and operate a street railway running from the old southern bridge over the Argentine boulevard, Seveoth street viaduct and Seventh street, to the northern city limits, has returned from New York, where he has been making arrangements for money to build the road. Mr. Thayer met with good success, and it is stated that work on the road will be commenced within thirty days. It is probable that electric motor power will be adopted at first, although a trial of the compressed air motor may be given. The franchise is considered the most valuable one ever granted by the council, inasmuch as Seventh street is regarded as the principal thoroughfare leading from the northern to the southern city limits. The cost of building the road and equipping it with the best rolling stock will aggregate over $500,000.

The company is not altogether satisfied with the franchise, although it has deposited a certified check for $5,000 with the city clerk as a guarantee to fulfill the contract, and the council will be asked to make a few changes. T. J. Enright stated that everything was in readiness to begin work, but the matter would be delayed until the council acted on the amendment. P.

Boston, Mass.

BOSTON, April 25.—Quite a large audience gathered at the Institute of Technology last evening to listen to a lecture by F. M. Gilley, a member of the Boston Electric club, upon the "Central Electric Lighting Stations of London." Mr. Gilley collected the information embodied in his lecture during his stay in London in the summer of 1889, after visiting the Paris Exposition. After referring to the fact that England far surpasses the United States in red-tape legislation, and pointing out the legal steps which it was necessary for a company to take in order to become properly authorized to transact an electric lighting business, the lecturer said that in England the business of manufacturing electric light apparatus is not under the control of a few large companies that use one system and work exclusively under the patents of some one inventor. Ready-made machinery is not to be found in stock. Almost every engineering firm makes a variety of systems, and no two installations look alike. Experimental work is often done in commercial stations, and thus the successful completion of the plants is often somewhat retarded. In striking contrast are the careful laboratory tests of new apparatus in this country, and the ready supply of the same when satisfactory. Consumers' rights are carefully guarded, maximum price fixed, no dividends allowed in excess of 8 per cent., unless the price to consumer is proportionately reduced, and mains and meters must be regularly inspected. Companies receive generous concessions, subsidies in the form of contracts for street lighting, and land grants for poles. Current must be furnished at all times and to every applicant, and at a price not in excess of a fixed amount. The two and three wire direct systems are in use only to a very limited extent. The real competition is between the alternate current and the storage battery systems, the former having the larger number of plants. Competition has been allowed and even favored by the Board of Trade, especially where the competing companies operate different systems, such as the alternating and direct current. Most of the stations are under the street, or underground in the rear of large buildings. Many chimneys are built of glazed brick, making them appear much less prominent as seen against the sky. Very few dynamos of English make run cool, the iron in some cases being very hot. Coal in some cases costs $6.00 per ton delivered. In the Crompton station at Kensington High Bridge, the cost of producing 1,000 watts was given as 2 cents. The Board of Trade unit of measure is 1,000 watts, now adopted in this country by one large company. This is very nearly equal to twenty 16-candle power lamp hours or 100 cu. ft. of gas. An effort is being made to have the unit increased to 10,000 watts, so as to correspond as nearly as may be to 1,000 cu. ft. of gas. London gas costs 60 cents per 1,000, and the price charged for electric lights is about equivalent to gas at $1.50 per 1,000. Many storage cells are in use. With the newest type, depreciation is said to be less than 5 per cent. One plant valued three years ago at $1,000, is now valued at $800. One firm guarantees its batteries to have less than 12 per cent. depreciation. Electric motors are not in use to any great extent. Most elevators are run by hydraulic power distributed at 700 pounds' pressure per square inch. A 60-foot elevator run by this power costs only $36 per year, and with this the electric motor must compete. The Aron current meter is extensively used. There is great antipathy to the use of leather belts, and this has resulted in the use very largely of direct coupled engines and dynamos. Incandescent lights in London are of inferior quality. The light is not steady, never above candle power, but is of a dull red color. The American "expert" has a counterpart in the English "engineer." The height of his ambition is to become "attached" to the staff of some noted engineer, and superintend or direct practical work without going through the hard work and the experience himself. Manual labor is deemed menial, and young men of the middle classes shun it. At the close of his lecture Mr. Gilley exhibited, by means of the lantern, about 70 views of the exterior and interior of the London stations and their surroundings. Views were shown of the incomplete details of the Ferranti plant at Deptford. The photographs and lantern slides were all made by Mr. Gilley himself, who seems equally well at home with his camera, in the chemical laboratory, or discussing electrical problems.

The annual report of the Thomson-Houston Electric company was made public this week. The business of the year, ended February 1st, aggregated $8,000,000 against about $4,000,000 for 1888, and $2,000,000 for 1887, an increase of 100 per cent. each year. The most interesting figures in the report are contained in the following table, showing the statement of profits and surplus account, and the number of Thomson-Houston arc lights in use for each year since 1883:

	Added to surplus from profits.	Total surplus.	No. of companies.	No. of arc lamps.
Jan. 1, 1883.....	$ 17,237	.....	5	365
" 1884.....	93,696	$ 110,934	31	2,478
" 1885.....	96,187	207,111	59	5,867
" 1886.....	106,687	313,809	100	13,227
" 1887.....	123,006	426 815	171	21,840
" 1888.....	313,596	750,411	303	36,936
" 1889.....	660,828	1,411,240	419	51,621
" 1890.....	1,300,175	1,685,415	587	68,203

In addition to this enumeration of companies, about 400 are operating between 300,000 and 400,000 incandescent lamps About 100 lines of electric railway are in operation, aggregating over 1,000 cars, as a result of less than two years' operations in this department.

The first "ladies' night" at the Boston Electric club passed very pleasantly and very successfully last Wednesday evening. About 150 persons were present. Among the attractions was a handsome working model of an electric car motor, which was carefully examined by the ladies. A phonograph discoursed music, instrumental and vocal, and told laughable stories. Phonograph dolls assisted in furnishing amusement by repeating Mother Goose and other childish tales. A banquet was served at the club rooms at 10 o'clock.

Frank Mansfield will read a paper at the Electric club next Monday evening, entitled "Single vs. Double Trolleys for Electric Railways."

City Engineer Jackson of Boston, had a call a few days ago from H. Igarashi, M. E., electrical engineer of Tokio, Japan, who is on a tour of inspection, seeking information of an electrical nature for the use of his government.

The quarterly statement of the New England Telephone & Telegraph company shows an increase of net earnings of $18,141 over the corresponding quarter of 1889. During the first quarter of 1890, $42,928 have been expended upon construction alone.

The report of instrument output of the Bell Telephone company for the month ending April 20th, shows a net increase of 799 instruments over the corresponding month last year. In 1889 the gross output for the month was 5,314, of which 1,943 were returned. In 1890 the gross output was 6,062, and the number returned was 1,892. Since December 21, 1889, no less than 18,881 instruments have been put out, an average of about 150 per day.

The committee on manufactures of the state legislature which went some time ago to Richmond and Philadelphia, to examine the workings of the city gas and electric plants in operation there, has returned home, and made its report this week to the senate. The committee was sent, because of the order now pending in the senate in relation to allowing cities and towns the right to operate municipal plants. The decision of the committee, after carefully investigating the plant in these two cities—their size, power, expense of operation and profit to the city—is "that it would be inadvisable for the legislature to enact a law giving municipal control of gas and electric light plants to cities and towns."

The West End Street Railway company is experimenting at its Allston power station with burners, for the use of crude petroleum oil under the boilers. O. H. M.

BOSTON, April 22.—An opportunity has been afforded this week to patrons of the long-distance telephone service between Boston and New York to hear over the wires the performance now being played at the various theaters in New York city. In this way Miss Lillian Russell, singing *The Grand Duchess* on the stage of the Casino in New York, has been heard and enjoyed by several Bostonians while sitting in their own parlors, 240 miles away. This opportunity of testing the capabilities of the long-distance telephone is afforded through the medium of the Woman's Exchange exhibition at the Lenox Lyceum in New York. The theater stages are connected with the temporary telephone exchange at the Lyceum hall, and this, through its connection with the central exchange in New York, places all the theaters of the city within "hearing distance" of Boston subscribers.

Music transmitted from New York to Boston in this way must be looked upon, however, as something of a luxury, as it costs the listener $1.50 for each five minutes. During the week Mayor Hart and other city officials at the City hall have listened to the music at the New York Casino in this way. It comes very distinctly over the wires, and at times, it is said, even footsteps of those crossing the stage can be heard.

At a meeting of the American Folk-Lore society, held last evening at the rooms of the Boston Society of Natural History, Dr. J. A. Fewkes illustrated his lecture on the Passamaquoddy Indians by phonographic reproductions of songs and tales of that people. This novel feature proved quite an attraction. Songs were reproduced, such as are sung at sacred dances and at the election of the chief of the tribe. One of these songs has, by the aid of the phonograph, been set to music, so that it may be played upon the piano or other musical instrument. A phonograph cylinder, containing a record of an Indian narrative, called the "Black Cat," was used to illustrate the narrative style of the Indian. Dr. Fewkes pointed out that the phonograph is destined to play an important part in the study of language, affording, as it does, exactness and preservation for an indefinite period of time of the matter recorded upon it.

The meeting and dinner of the Boston Electric club were well attended last Monday night, the attraction being an address, illustrated by many lantern slides, upon "Electric Railway Evolution," by Joseph Wetzler. Short speeches were made upon the same subject by F. H. Monks general manager of the West End Street Railway company, and by George W. Mansfield of the Thomson-Houston Electric company's railway department.

The annual meeting of the New England Electric exchange was held on Monday at the rooms of the Boston Electric club. The vote for new officers resulted in the choice of Alexander P. Wright for president; H. H. Fairbanks of Worcester, secretary and treasurer; and of E. H. Hewins, H. C. Spaulding and W. S. Hill for directors. The treasurer's report showed a surplus in the treasury of $183.

The death of Benjamin Franklin Sturtevant, the well-known inventor and manufacturer of the blowers which bear his name, and to many of which electric motors

are now attached, occurred at his home in Jamaica Plains, Boston, on the 17th inst. It was a curious coincidence that his death should occur on the 100th anniversary of the death of the inventor whose name he bore. O. H M.

THE ELECTRIC LIGHT.

An agitation is on foot in Denton, Tex., for an electric light plant.

The erection of an electric light plant at Berkley, Va., is contemplated.

The Portsmouth, Va., Electric Light, Heat & Power company's plant will soon be under way.

Middletown, Del., has a 900-light plant, and an effort is now being made to install another station.

The Aurora, Ill., Electric Light & Power company will install a Thomson-Houston 35 light arc machine.

The installation of an electric plant at Cameron, Tex., is projected by capitalists interested in the town.

A $50,000 electric light plant will be erected at Falmouth, Ky., where a new company has been organized.

The Progress Electric Light company at Mobile, Ala., is adding new machinery and otherwise improving its plant.

The Central City Electric Light & Power company has been organized at Radford, Va., and will erect a power house at once.

The Standard Stamping company, of St. Louis, Mo., will install a Thomson-Houston plant of 200 direct current incandescent lights.

An electric light plant will be installed at Douglassville, Fla., and operated by water power. A large dam is now in course of construction.

The Westinghouse Electric company has just closed an order for a 750 light incandescent outfit from the St. Thomas (Ont.) Gas company.

The Thomson-Houston Electric company has sold to the Atchison Gas, Electric Light & Power company, a 300 light direct current incandescent machine.

Thirty-seven arc lamps are used to illuminate the streets of Mt. Clemens, Mich., and 600 incandescent lamps are used for lighting the stores and residences.

The Thomson-Houston Electric company of Clinton, Ia., has increased its capacity by the addition of a 1,000 light alternating current incandescent dynamo.

The East Chattanooga, Tenn., Land Improvement company is considering the question of erecting a power station and furnishing electric light and motor service.

The Belton, Tex., Electric Light company has its plant in operation, but finds the demand so great that its capacity is already overtaxed, and new apparatus will have to be added.

Susquehanna, N. Y., is soon to be a well lighted town. The company which is to do the lighting starts out with a capacity of 750 Westinghouse incandescent lights, and 80 arc lights.

The Westinghouse arc lighting system has been adopted by the Evanston Electric Illuminating company of Evanston, Ill. The arc light plant will have an initial capacity of 120 lights.

The Uxbridge & Northbridge Electric company of Northbridge, Mass., has placed an order with the Westinghouse Electric company for an arc light machine of 60 lights' capacity.

Martin's Ferry, O., is to use the new arc lighting system manufactured by the Westinghouse Electric company. An order has just been placed with the Westinghouse company for a 40 light machine.

Carroll & Powell, of St. Louis, Mo., have purchased complete lighting outfits for two steamboats. They will use the Thomson-Houston arc and focusing lamps, together with headlights and reflectors.

For some months a 750 light alternate current incandescent machine of the Westinghouse manufacture has been in use at Sherman, Tex. The company operating the machine has just placed with the Westinghouse Electric company an order for an additional machine of 750 lights' capacity.

The United Electric Light & Power company of Springfield, Mass., a few days ago ordered of the Westinghouse Electric company an increase of 3,000 incandescent lights capacity to its present plant. The United company has in use Westinghouse dynamos of a capacity of more than 5,000 lights.

Fifty-four electricians met in Boston recently and formed a society to be known as the Massachusetts Electrical Engineers' and Mechanics' association. The following officers were elected: President, John Dean, Jr.; vice-president, James E Monroe; secretary, C. H. Tyler; treasurer, Andrew Hanson.

The electric light companies at Brookline, Mass., and Johnstown, N. Y. have just concluded contracts with the Westinghouse Electric company for special machinery for long distance lighting. The Brookline plant is to have an apparatus of 900 lights' capacity and Johnstown of 500 lights' capacity.

The Citizen's Electric Light & Power company of Montgomery, Ala., has been organized and will install a Ball plant. The following named gentlemen have been chosen for a board of directors: H. T. Beggs, F. Lilienthal, C. G. Abercrombie, H. C. Davidson, P. B. Bibb, Alex. Rice, and W. H. Gesner. The board of directors elected the following officers: P. B. Bibb, president; H. C. Davidson, vice-president, and W. H. Gesner, secretary.

The Camden, Ark., Electric Light company contemplates adding an incandescent plant to its installation for arc lighting.

Gas explosions in the subways in Paris are attributed to the leakage from the public mains, and steps will be taken to cause the replacement of the present system by properly constructed gas mains. "Practical Americans," so called, who would abolish the use of electricity and continue to inhale impure air should consider this example.

The Ouray Electric Light company of Ouray, Colo., one of the oldest alternating current central station plants of electric lighting in the country, a few days ago contracted for an increase in its capacity. The Westinghouse Electric company is now occupied with putting up one of its 750 light machines, making the total capacity of the plant 1,500 lights.

THE ELECTRIC MOTOR.

Fourteen new motor cars have been ordered by the Federal street and Pleasant Valley street railway at Pittsburg, Pa. At present 25 electric cars are in operation, and they are giving satisfaction to the public and the railway company. The Sprague system is in operation.

The organization of the Birmingham, Ala , Electric company by the consolidation of the Ensley Railway company, Birmingham Union Railway company and the Birmingham & Bessemer Railroad company is contemplated, and it is proposed to erect several electric power plants to operate the roads by electricity.

The main lines of the Rochester, N. Y., Street Railway company will be equipped with electric motors and in operation by November 1st. The company has awarded the contract for 100 motors to the Short company, and 100 new vestibule cars made by the Gilbert company, will be put into service at that time.

The Sprague company has completed the construction of an electric system at Sioux City, Ia. According to the local papers, the new road is giving satisfaction, the service afforded being far superior to the cable line which was established some time ago. The construction work was superintended by J. M. Atkinson.

The commission appointed by the St. Louis council to appraise damages sustained by the Market street, Broadway, Union and Union Depot lines against the Southern railway for occupation of their tracks from Sixth and Market streets by way of Broadway to Wash street and return, are now investigating the claims of the contending corporations.

The substitution of electricity for horses and mules on the street car lines of St. Louis will place a large amount of stock on the market. It is estimated by the owners of the lines that by July 4th the companies will be enabled to dispose of 4,665 horses and mules, which are now utilized for hauling cars. These animals represent about $500,000 capital.

The official report of the proceedings of the eighth annual meeting of the American Street Railway association at Minneapolis, has just been presented in pamphlet form. Much attention was given electric systems at this meeting, and the report of the convention should be secured by all interested in electric railway work. The next meeting will be held at Buffalo, N. Y., October 15th.

The New York *Sun* is responsible for the following note: "The conductors and engineers on the Ottumwa electric street railway have struck vainly for shorter hours and the privilege of smoking while on duty. The latter demand seems rather curious. It indicates on the part of certain citizens of Iowa an appetite which a consistent prohibition state should at once abolish or order to be abolished by statute and constitutional amendment."

At a meeting of the Board of Public Improvements, St. Louis, last week, President Johnson of the Southern Railway company, submitted plans of the positions of the iron poles along the line of the railway from Market street to Russell avenue. The Union Depot Railway company was granted permission to lay a temporary "T" rail along Arsenal street, between Grand avenue and King's highway. The track is to endure until eighteen months have expired, or until the street is improved

The Bellefontaine street railroad, St. Louis, will soon be equipped with an electric system and placed on a first-class footing. Last week articles of incorporation were filed for an organization to be known as the Motor company, with a capital stock of $10,000. The stockholders are James Campbell, Emerson McMillan, J. C. Van Blarcom, John Scullin and Robert McCulloch. Mr. Campbell was asked what electric system would be used on the road, but he replied that he was making investigations of various systems and had not decided, as yet, which one was the best. The road will be equipped as soon as arrangements can be perfected.

Miscellaneous Notes.

The Chicago Aluminum Manufacturing company, has been incorporated at Chicago; capital stock, $1,000,000; incorporators, M. L. Marston, Franklin Babcock, F. B. Medica.

The Electric Wheel company has been formed at Quincy, Ill., for the purpose it is stated of manufacturing metal wheels by the use of electricity; capital stock, $25,000: incorporators, S H. Enery, Jr., Thomas Hill, and C. G. Comstock.

The Anaconda, Mont. *Standard* says in its issue of April 21st: The dynamos lately placed in the building erected for the new refining plant in this city are veritable monsters, each representing 125-horse power. They will be in operation soon. Last evening's train brought to this city F. B. Badt, of Chicago, who will get the ponderous machinery at the refinery in motion within a few days. Mr. Badt is one of the Edison company's chief experts.

The development of the electrical interests and the advances made in the transmission and application of electric power has served to stimulate many other industries which heretofore gave little promise. Trade journals report a large demand for creosoted wood, and announce that the use of this material in the manufacture of underground electric conduits has brought this branch into unexpected prominence in commercial circles.

Personal Mention.

Frank E Snow of the Detroit Electrical works, is in Chicago.

J. S. Doe, of the Jeffreys Manufacturing company of Columbus, O., was in Chicago last week.

W. A. Jackson, vice president of the Detroit, Mich., Electrical works, was in Chicago last week.

Geo. F. Porter, Philadelphia representative of the Westinghouse Electric company, was in Chicago Tuesday on his way to the Pacific coast.

Among recent visitors at the Chicago Electric club were the following: E. Rathenau, Berlin, Germany; G. P. Wilson, Philadelphia; A. E. Graham, Pueblo, Colo.; E. W. Tucker, San Francisco Cal.; G. N. Black, Springfield, Ill.; David Highland, Chicago,; J. F. Phillips, Chicago.

Business Mention.

The Mitchell Vance company have just issued a new catalogue, No, 3, containing sixty plates of beautiful designs of combination and electric light fixtures.

The New England Electric company, New England, agent of the Sprague Electric Railway & Motor company, has removed to its new offices 12 Post Office Square, Boston.

The headquarters of the Storage Battery Motor company has been established at 606 First National Bank building of Chicago. This company is manufacturing the Detroit storage battery.

The Excelsior Electric company, Chicago, will shortly move from its present quarters on Adams street, and will occupy the suite of offices in the Rookery building recently vacated by the Leonard & Izard company.

J. W. Parker, late with Messrs. H. M. Sciple & Co. of Philadelphia, has taken the agency of the Ball Engine company and has opened his office at 38 S. Fourth street, Philadelphia. Mr. Parker has been selling the Ball engine for some years, and is well known to the trade.

E. E. Harbert, Chicago, dealer in general electric supplies, has recently removed his establishment from the South side to the corner of Van Buren and Desplaines streets. Mr. Harbert, besides doing business in electrical novelties of all sorts, is handling a mechanical telephone.

Jean A. Wetmore, of the Norwich Insulated Wire company, was in Chicago last week. Mr. Wetmore has just finished putting in two miles of his wire with paper insulation for the Chicago Arc Light & Power company. He left for Detroit Monday and will superintend the work of construction of a four mile circuit for the Detroit Arc Light company.

Bernard Lande of the Anglo-American Electric Light company of New York city, the eastern manufacturers of the Sorley battery, states that his company will soon move into its new factory at Kensington, Conn. The new building is large and admirably adapted to this class of work and the company will now be able to fill the orders for their batteries, which have been accumulating for a number of months past.

The Pond Engineering company will furnish the Streator Electric Railway company, Streator, Ill., a complete steam plant including two 125-horse power Armington & Sims' engines, Hoppe's feed water heater, and pumps, pipe work, etc., erected complete. The company's Kansas City office will place a 1-horse power Armington & Sims' engine, in the Washington Apartment House in that city. The company's sales of Sheffield grate bars and Standard rocking grates are reported large.

The Taylor Manufacturing company of Chambersburg, Pa., have received orders for Beck automatic engines from the following concerns: The Metropolitan Street Railway company, Portland, Ore.; Randolph-Macon Academy, Liberty, Va.; Grand Rapids, Mich. Brass company; Augusta, Ga., Summerville railway; Hill City Electric Light company, Vicksburg, Miss.; W. N. Brown, Mount Pleasant, Mich.; Basine Manufacturing company, Baltimore; Newcastle, Pa., Electric company; Muscatine, Ia., Electric Light & Power company; Connell, Hall & McLester company, Nashville, Tenn.; Hotel Normandie, Washington, D C.; J A. Clark, Morgantown, W. Va.; Grand Central depot, New York city; Steamer St. John, Jersey City; Bank of America, New York city.

"The South's Redemption," by Richard H. Edmonds, a pamphlet in which is reproduced interesting statistics from the *Manufacturing Record* of Baltimore, has just been issued. This interesting document reviews the commercial progress of the South since the end of the late civil war. At that time the Southern states were reduced to abject poverty, but the great natural resources of the country have since been diligently developed, and now, it is claimed, they are fast approaching the condition they were in immediately preceding the struggle. Mr. Edmonds presents valuable statistics and interesting information concerning the industrial development of that section, which may be studied with profit by Northern capitalists. In no other department of industrial activity will this evidence of prosperity

be more joyfully received than in electrical circles, for the progress of the South means the development of a practically new field for manufacturers of electrical apparatus.

The Weston Electrical Instrument company, will hereafter occupy as its factory, the four-story brick building at 114 William street, Newark, N. J. It is at present fitting it up with a full line of machinery for the manufacture of a general line of electrical instruments, as well as its celebrated ammeters and voltmeters. These latter instruments have been improved in form and increased in range. The demand for them is daily growing more general, owing no doubt to the fact, that they have to a large extent been adopted as standard instruments.

The Illinois Anglo American Storage Battery company has recently rented the upper floors of the building at 40 and 42 W Quincy street, Chicago, for the purpose of manufacturing storage batteries under the Sorley patents. These patents the company controls in the states of Ohio, Indiana, Illinois, Michigan and the entire west and northwest. The building which the company has chosen for its factory is admirably adapted for the purpose, being light and airy. The great feature of the battery manufactured under the Sorley patents is the plate. This plate which was recently illustrated in the columns of the WESTERN ELECTRICIAN, it will be remembered, is made of leaden tape worked into a peculiar shape so as to form spaces in which the active material is contained. After the grid is formed in the manner just described, it is passed to the soldering room where it is strengthened in a manner which makes it firm and keeps it in shape for receiving the active material. After the soldering process, the plate is conveyed to another department in the rear where the active material is put in in the shape of a dry powder. The plate is then conveyed to the forming room. After leaving the forming room the plates are assembled and the rubber guards and bolts put in place, and the terminals soldered. The battery is then ready for shipment. A point worthy of mention in the manufacture of this particular plate, is that the leaden tape referred to above is purchased from the lead manufacturers in a proper condition to be formed into plates From this it will be seen that the necessity of having a foundry in connection with the establishment for the casting of grids is dispensed with. As a foundry is a necessary adjunct to almost every other storage battery company in the market, the value of this feature will be appreciated. The current for forming the plates is furnished by a 220 volt Edison machine. J. B McDonald, president of the company, states that he has a large number of orders ahead for the different sizes of batteries. He also says that a large number of the cells were recently shipped to the Detroit Motor company. It is claimed that these batteries are admirably adapted for heavy street car service, and, that in all cases where used thus far, they have given perfect satisfaction.

The appended list of sales is of unusual interest, inasmuch as it illustrates the extended use which is now being made of electric motors. The sales were made by the C. & C. Electric Motor company, New York: Edison Electric Illuminating company, Brooklyn, one 3-horse power for ventilating station and one ½-horse power fan outfit; One 1-horse power to Pennsylvania R. R. shops, Altoona, Pa.; one 10-horse power to American Press association, Chicago, Ill.; one 1-horse power to Messrs. Gahl & Lembke, 21 Union Square, N. Y.; one 2-horse power to T. H Porter, Stamford, Conn., to run elevator; one 2-horse power to Edison Electric Illuminating company, Newport, R. I.; one 10-horse power to Sunday *Telegram*, Harrisburg, Pa.; one 1-horse power to First Presbyterian church, Easton, Pa.; one 1-horse power to J. H. Simpson, 154 W. Twenty-third street, N. Y., to run ventilating fan; one 3-horse power to Edison Electric Illuminating company, 432 Fifth ave., New York; one 8-horse power to the Solomon Lord building, Eighteenth street and Broadway, running elevator; one 1-horse power to "Thompsons," 25 E. Fourteenth street, New York, running ventilating fan; one 1-horse power to Warren & Witherell, 201 Hanover street, Boston, Mass., to run coffee-grinding machine; one 2-horse power to St. Thomas church, Fifty-third street and Broadway, New York, to run ventilating fans; one 1-horse power to Edison Electric Illuminating company, Fall River, Mass.; one 1-horse power to C M. Gage, Champion Card & Paper company, Pepperell, Mass ; one 5-horse power to Fletcher & Co., Portland, Me., to run elevator; one 5-horse power to Dr. Kilbourne, president of Seattle Electric Railway & Power company, Seattle, Wash.; one 2-horse power to Ryan Bros., Appleton, Wis.; one 1-horse power to *Court Journal* Publishing company, 608 F street, Washington, D. C., to run press; one 2-horse power to B. F. Robinson, 21 Broadway, Lawrence, Mass., to run lathe; one 5 horse power to Fell & Josephs, Wilmington, Del., to run elevator; one 4-horse power to Bradley Fertilizer company, N. Weymouth, Mass.; one 4-horse power to Allen & Kenway, 220 Devonshire street, Boston, Mass., to run ventilating blower; one 2-horse power to Howard & Co., 264 Fifth ave., New York, to run jewelers' lathe and polishers; one 1-horse power to Trinity church, Easton, Pa.; one 3-horse power to Whiting Manufacturing company, Union Square, New York, to run jewelers' lathe and polishers; one 4-horse power motor to Prof. C. A. Young, Halsted Observatory, Princeton, N. J , to turn observatory dome; one 5-horse power to Fraser & Chalmers, Salt Lake City, Utah, to run a dynamo; one 3-horse power motor to Leighton & Wilson, Phœnix building, Salem, Mass.; one 2-horse power motor to Kobe, Japan; one 5-horse power motor to G. B. Grant, 137 Franklin street, Boston, Mass ; one 15-horse power to Snyder & Black, 92 William street, New York, to run lithographic and printing presses; one 1-horse power to Wickstead Umbrella company, 47 John street, New York, running machine shop; one 1-horse power to Church of Holy Communion, Sixth ave. and Twentieth street, New York; one 3-horse power and one 10-horse power to W. R. Sanderson, 194 Water street, New York, running printing presses; one 10 horse power to Trask Milling Machine company, 118 South street, Boston, Mass., running machine shop; one 1-horse power to Southern District Telegraph & Electric company, Birmingham, Ala., to run printing presses; one 1-horse power to Roanoke Electric Light & Power company, Roanoke, Va., used in printing the Roanoke *Daily Herald*; one 1-horse power to General Society of Mechanics & Tradesmen, 18 E. Sixteenth street, New York, to run ventilating fan; one 1-horse power to St. John's church, Reading, Pa.; one 15-horse power to William Silverman, the Wire Buckle Suspender company, Williamsport, Pa., to run shop; one 5-horse power motor to John J. Tuomey, Jackson, Mich.; one 15 horse power to W. W. Bullock, Wilmington, Del.; one 3-horse power to D. P. Gosline, 32 Oliver street, Boston, Mass., ventilating fan; one 15-horse power motor to Queen City Electric Light company, Gadsden, Ala ; one 1-horse power to the Silvey Electric company, Lima, O.; one 2-horse power motor to Meyer, Singer & Co., Lycoming Pants Factory, Williamsport, Pa., to run sewing machines; one 4-horse power to D. Coughlin, 5 Mill street, Lawrence, Mass., to run 28-inch saw; one 1-horse power motor to Trinity Episcopal church, W. Fourth street, Williamsport, Pa., to run organ bellows; one 7-horse power motor to Mercantile Printing company, Wilmington, Del., to run presses; one 20-horse power to Perry & Woodworth, Smith building, Cincinnati, O.

Electrical Patents.

Issued April 22, 1890.

425,990. Electric Machine for Covering Wire, etc. Frank E Davis, Boston, and John Scott, Jr., Plymouth, Mass.

425,991. Electric Motor. Frank E. Davis, Boston, and John Scott, Jr., Plymouth, Mass.

The object of the invention is to secure equality of speed between several motors and to provide means for stopping such motors simultaneously. The invention consists in a plurality of electric motors having all their armatures in the same circuit, in combination with a switch in said circuit, and means for operating the switch to successively insert resistances in the circuit, break the circuit, and short-circuit the armatures.

425,995. Electric Fan. Philip Diehl, Elizabeth, N. J.

425,999. Process of Manufacturing Electrodes for Secondary Batteries. Ludwig Epstein, Berlin, Germany.

426,009. Bell and Engine Indicator for Pilot Houses of Steam Vessels. William E. Hadlock, Wenham, Mass.

426,024. Magnetic Circuit-Closer. John von der Kammer, New York, N. Y.

426,049. Electric Switch. James P. Norton, Detroit, Mich.

426,055. Incandescent Electric Lamp. James W. Packard, New York, N. Y,

The invention consists in an incandescent electric lamp, a stock for supporting the electrodes of said lamp, which consists of the solid central stem of such size that it can be joined to the base of the lamp by a flat seal, combined with four or more tubular branches from said solid central stem, together with the platinum electrodes embedded in the solid stem, and the copper extensions to the same, located in the tubular branches.

426,057. Fuse-Block. Thomas Patterson, Boston, Mass.

426,064. Insulating-Hanger for Overhead Supply Conductors. Frank B. Rae, Detroit, Mich.

The second claim is given:

"The combination, with a suitable form of metal hanger secured to an insulator, of a bell-shaped insulator and means for suspending the latter from a cross-wire, consisting of two hooked arms attached to the insulator by a clamping ring and clamping-screws."

426,065. Current Indicator. Frank B. Rae, Detroit, Mich.

426,066. Trolley Support. Frank B. Rae, Detroit, Mich

426,082. Safety-Connection. Elihu Thomson, Lyon, Mass.

The invention consists, essentially, in the provision of an insulating film somewhere in the safety or shunting ground wire, which insulating film normally separates or insulates two contacts or electrodes, but on being punctured, pierced, disrupted, or otherwise affected by the high tension current leaking to the secondary or local, will permit or cause electrical connection to be formed between such contacts by arcing and melting of the metal.

Claim one reads: "The combination, with a local or independent circuit or conductor liable to accidental connection with a high tension conductor, of a safety ground connection formed by wires or conductors adapted to carry the current of the high-tension circuit without interruption, such safety ground connection having interposed in it two contacts or electrodes separated from one another by a narrow insulating-film across which the high-tension current may force its way."

426,102. Electric Railway Contact. Francis O. Blackwell, New York, N. Y.

426,108. Safety Device for Dynamos. Ernest P. Clark, New York, N. Y.

The invention comprises an automatic safety device for shunt wound dynamos, consisting of a switch arm in the field magnet circuit and a spring tending to move the switch arm to break the circuit, a latch for holding the switch arm closed, and a magnet in the main circuit for holding the latch in engagement with the switch.

426,109. Safety Device for Dynamos. Ernest P. Clark, New York, N. Y.

426,110. Safety Device for Dynamos. Ernest P. Clark, New York, N. Y.

426,121. Insulated Joint. Emil F. Gennert, New York, N. Y.

426,127. System of Electrical Distribution. Charles J. Kintner, New York, N. Y.

The method consists in generating low tension currents, and conducting said low tension currents to a point below the earth's surface and then converting them into high tension currents and conducting said high tension currents to outlying points through conductors located entirely beneath the earth's surface, and then converting said high tension currents again into low tension currents, and finally conducting the same to the consumers

426,128. Wire Cutter. James Knibbs, Troy, N. Y.

426,134. Electric Signaling Apparatus for Hotels. John J. Miller, Cleveland, O.

426,153. Converter. Edmund Wagemann, Little Rock, Ark.

The invention consists of the combination of a secondary coil, and a primary conductor consisting of superposed plates of copper and iron arranged alternately with one another and surrounded by the said secondary coil, the axis of the said coil being perpendicular to the planes of the said plates.

426,155. Electric Lamp Hood and Support. Ernest P. Warner, Chicago, Ill.

426,156. Fuse Block. Frederick G. Warrell, Philadelphia, Pa.

426,189. Holder for Incandescent Electric Lamps. Philip H. Klein, Jr., New York, N. Y.

426,196. Apparatus for Hauling through Electric Cables. James F. Munsie, Chicago, Ill.

426,197. Underground Conduit. James F Munsie, Chicago, Ill.

The invention consists in the combination, with a man-hole, of a series of ducts extending within said man-hole, each duct being provided with an air exhaust port and with a separate cap piece, said cap piece having an opening for the insertion of a congealable liquid.

426 198. Insulator. James F. Munsie, Brooklyn, N. Y.

426,199. Duct for Electric Conductor. James F. Munsie, Brooklyn, N. Y.

426,200. Flexible Connector. James F. Munsie, Brooklyn, N. Y.

426,201. Insulating Lining. James F. Munsie, Brooklyn, N Y.

426,202. Insulating Compound. James F. Munsie, Brooklyn, N. Y.

426,203. Insulator. James F. Munsie, Brooklyn, N. Y.

416,204. Binding-Post. James F. Munsie, Brooklyn, N. Y.

426,205. Duct for Electric Conductors. James F. Munsie, Brooklyn, N. Y.

426,206. Man-Hole for Underground Electric Conduits. James F. Munsie, Brooklyn, N. Y.

The man-hole has low tension or battery wires passing through its upper portion, and high tension or electric light wires passing through its lower portion, a parallel conductor being placed between the two sets of wires, which is intended to neutralize or minimize the effect of induced currents.

426,222. Electric Railway Signal. George A. Tower, Richmond, Va.

426,247. Electro-Magnetic Instrument Patrick B. Delany, South Orange, N. J.

426,266. Coin-Controlled Apparatus for Telephones. William Gray, Hartford, Conn.

426,269. Electric Railway System. Ludwig Gutmann, Fort Wayne, Ind.

426,304. Thermostat. John P. McMahon, Buffalo, N. Y.

426,307. Electric Annunciator Call. William S. Paca, Baltimore, Md.

426,317. Coupling for Electric Cars. Louis Pfingst, Boston, Mass.

426,335. Armature for Electric Meters. Oliver B. Shalleberger, Rochester, Pa.

The invention consists in constructing the armature of a ring of magnetizable material carried by a disk of aluminium. The use of the aluminium disk renders the armature very light. This disk is spun into the ring, and is provided with annular corrugations, which serve to stiffen the metal.

426,338. Lightning Arrester. Arthur D. Spear, Greenville, S. C.

426,348. Dynamo-Electric Machine. Merle J. Wightman and Elihu Thomson, Lynn, Mass.

426,379. Electric Railway Car. John C. Henry, Kansas City, Mo.

426,380. Electric Motor and Dynamo. John C. Henry, New York, N. Y.

426,381. Electric Gas Lighter. Charles H. Hinds, New York, N. Y.

426,382. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

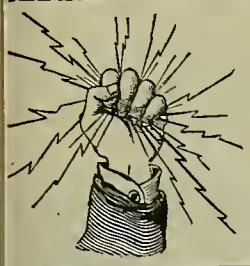
426,395. Apparatus for Electric Railway Signaling. Charles H. Rudd, Evanston, Ill.

426,405. Arc Light. James J. Wood, Brooklyn, N. Y.

The invention consists in the combination, with a carbon holding rod, of a carbon clamp having gripping jaws for engaging the carbon pencil arranged to hold the latter with its axis out of line with the axis of the rod, and connected to the rod through the medium of a swivel connection, whereby it may be rotated relatively to the rod.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



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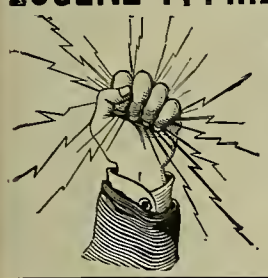

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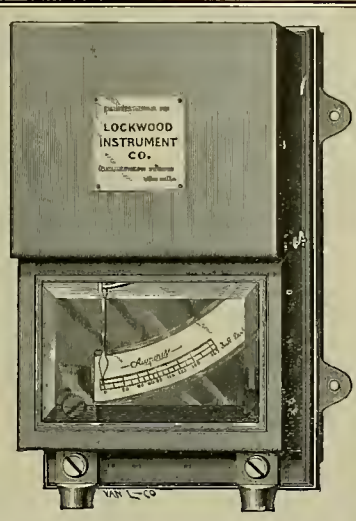

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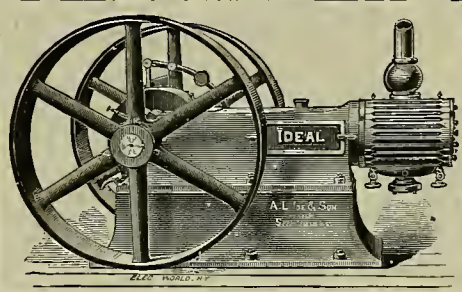

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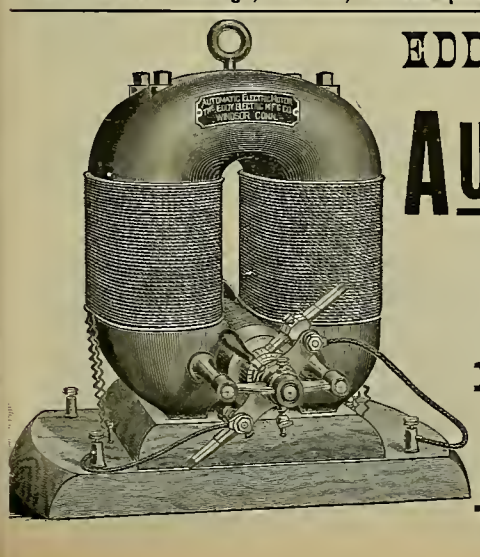

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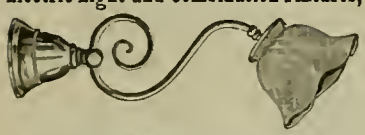

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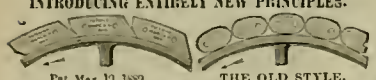

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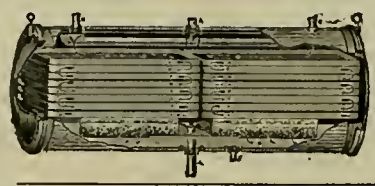

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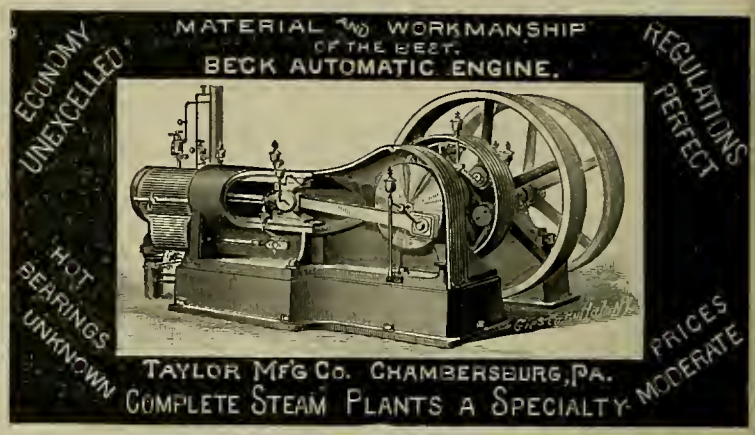

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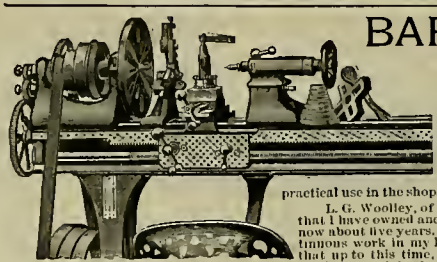

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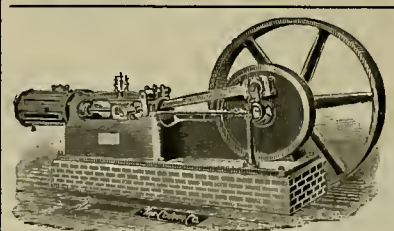

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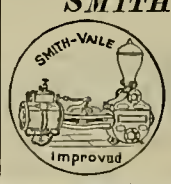

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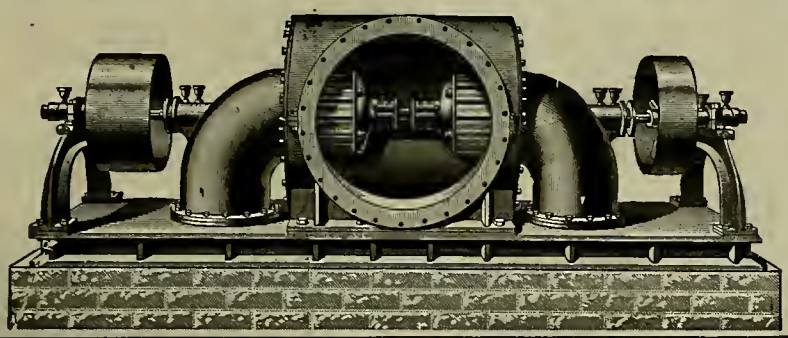

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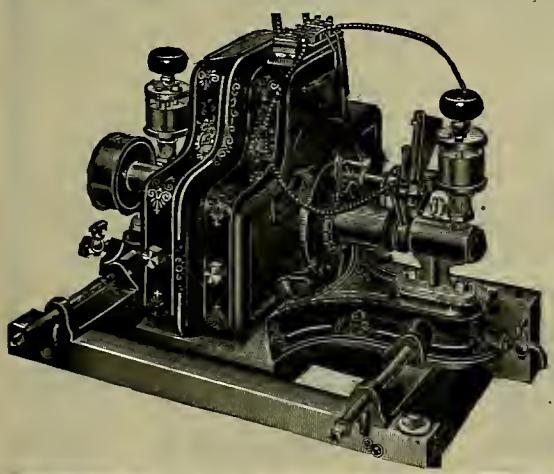

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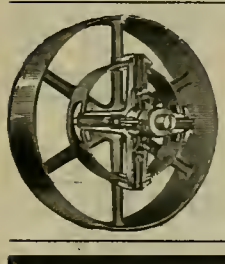

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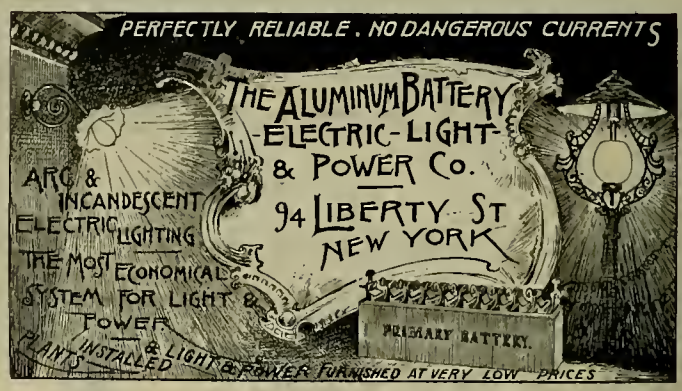

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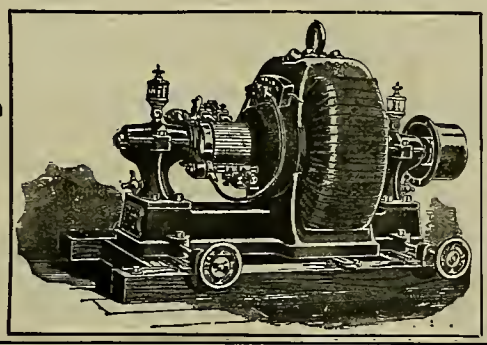

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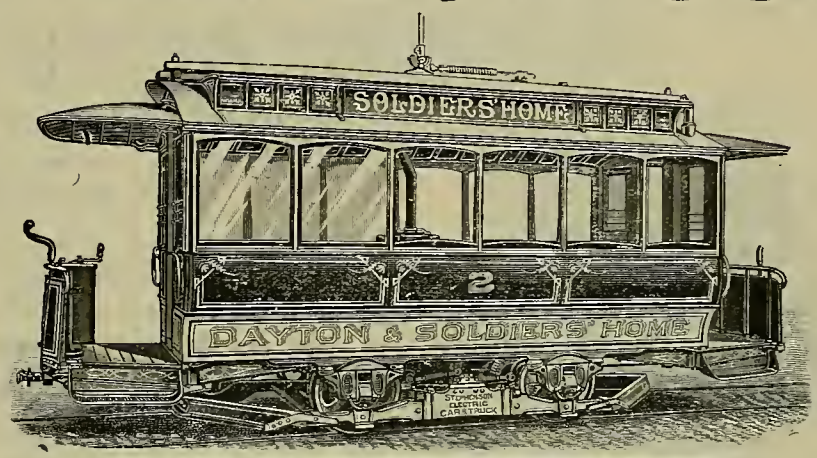

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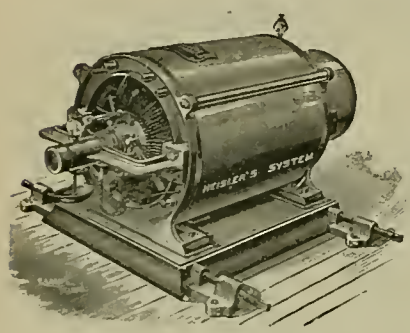

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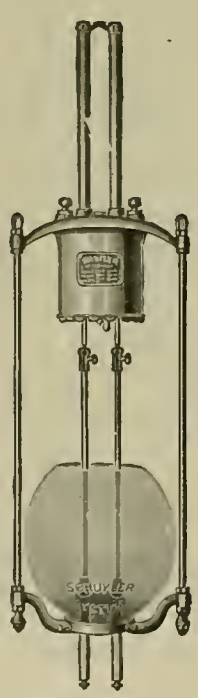

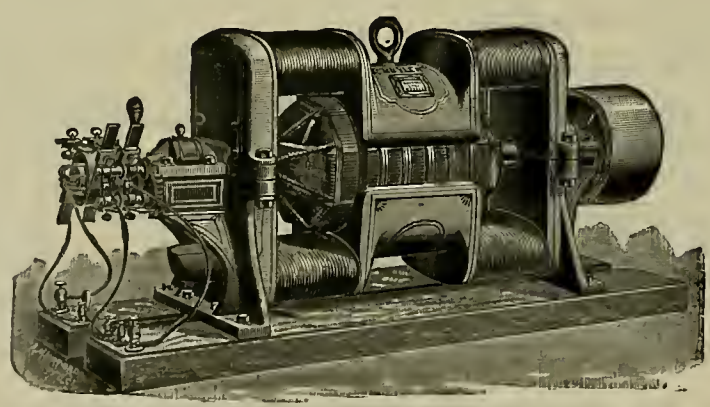

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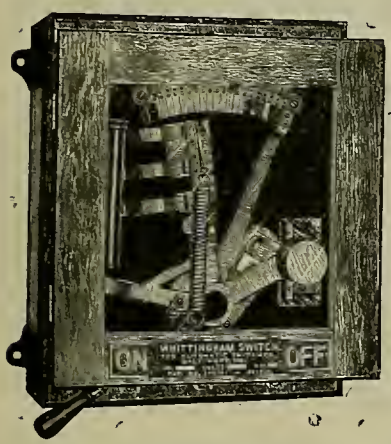

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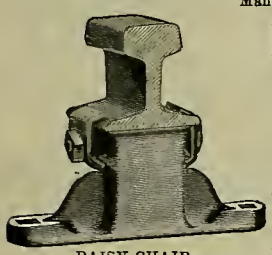

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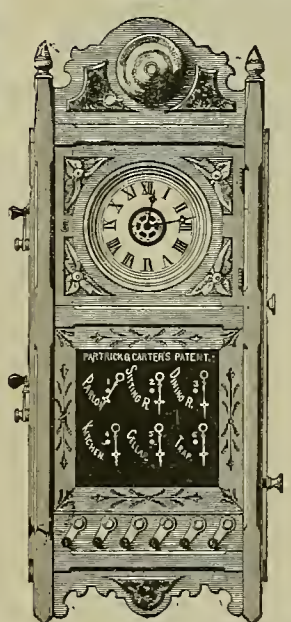

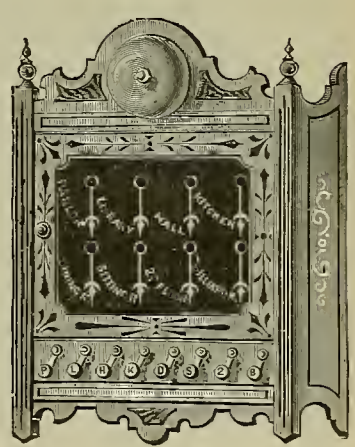

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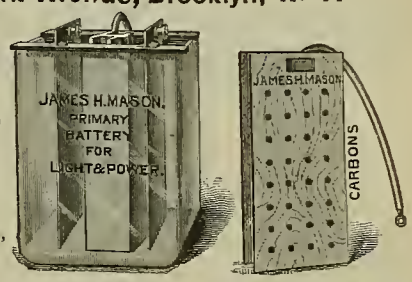

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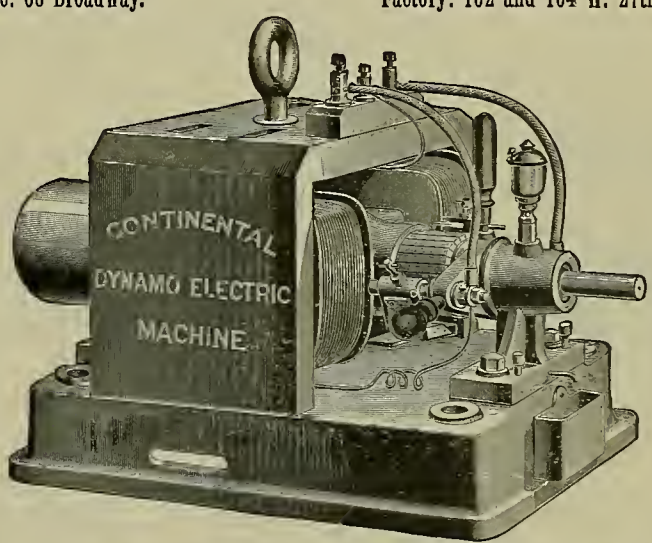

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219,208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219,208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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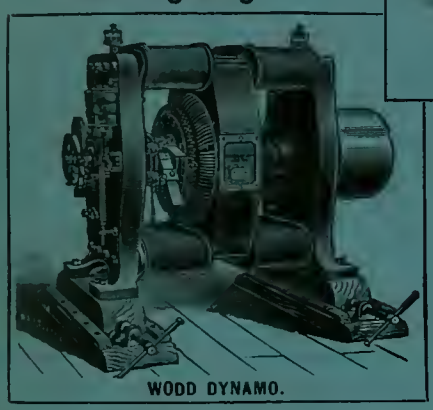

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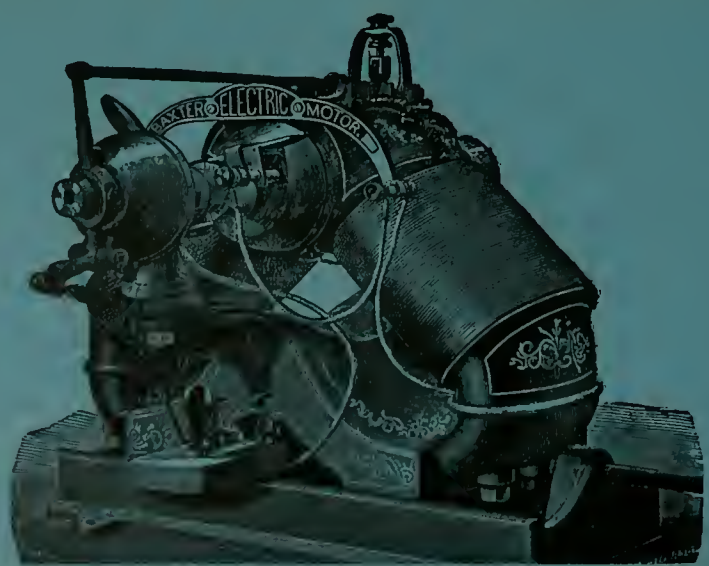

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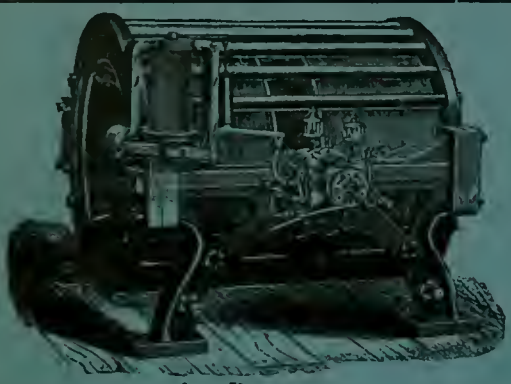

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No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent, are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.

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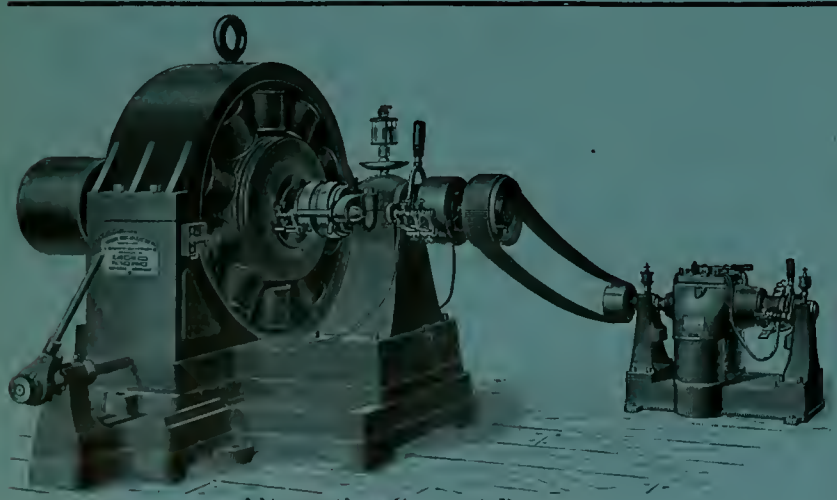

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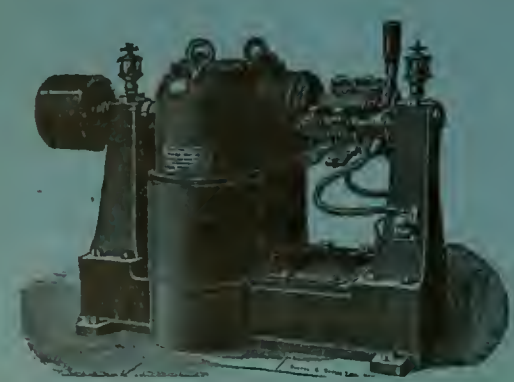
The problem of long distance incandescent lighting is practically solved by the alternating current dynamo, and to meet the demand for a machine of this character we have constructed what is unquestionably the most perfect alternater offered the public today, embracing as it does, all the features that combine to make a perfect dynamo—automatic regulation, perfect mechanical construction, highest efficiency, and economy of operation.



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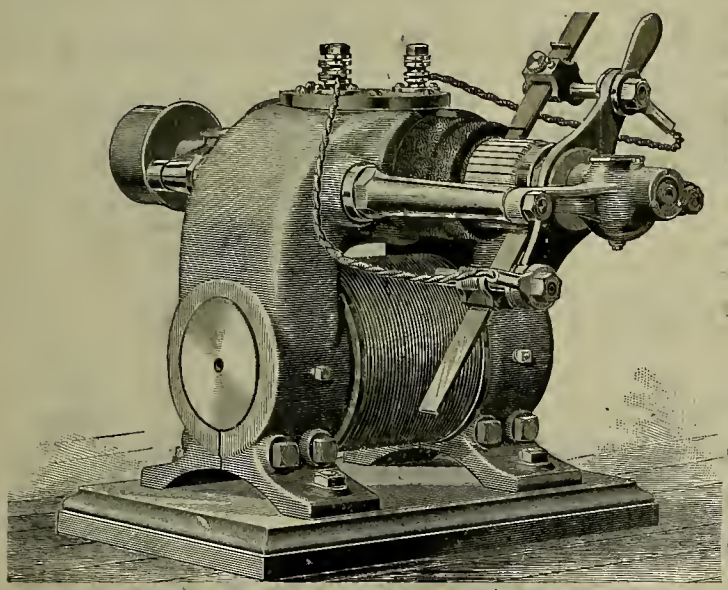

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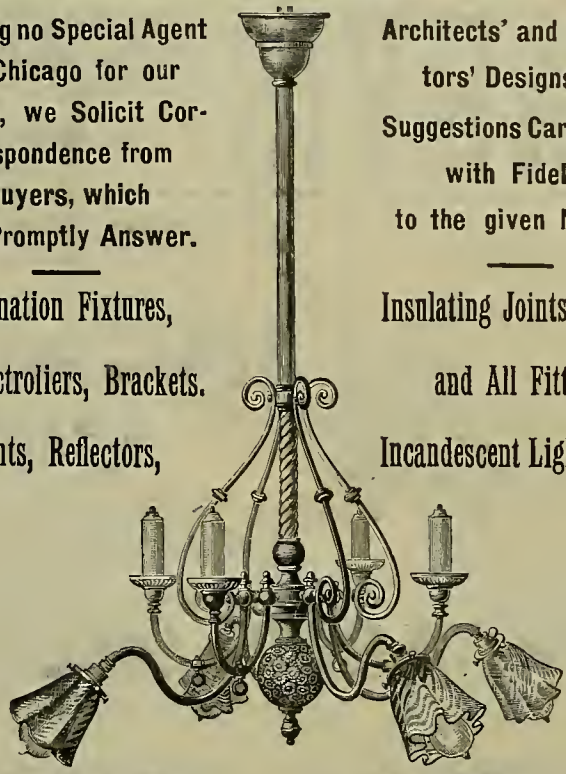

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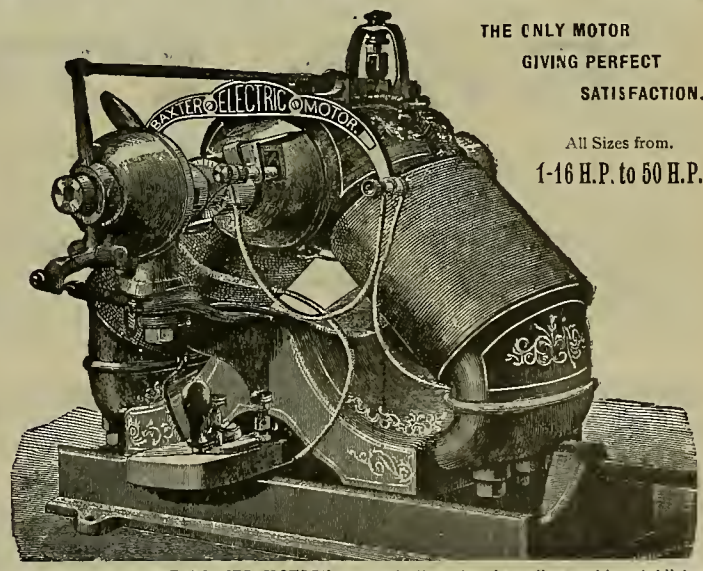

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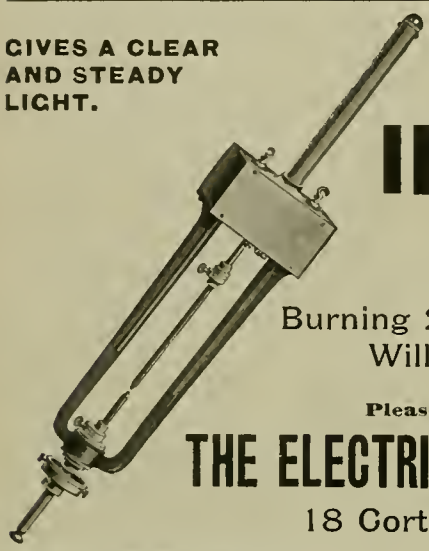

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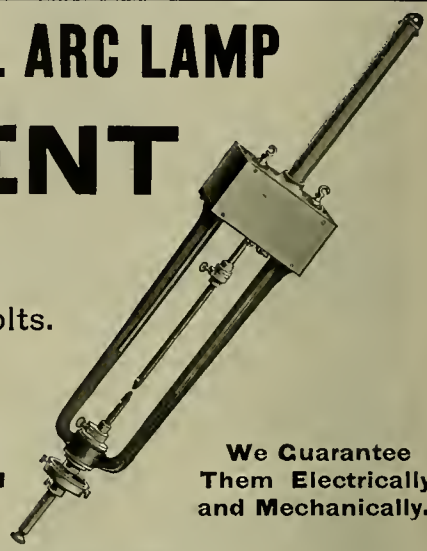

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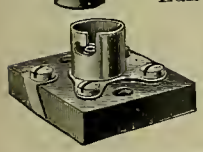

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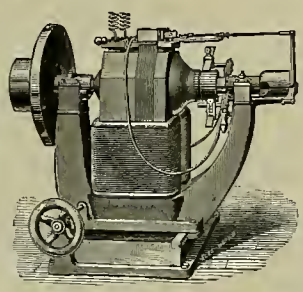

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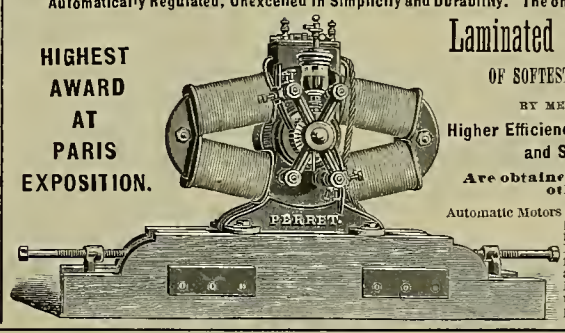

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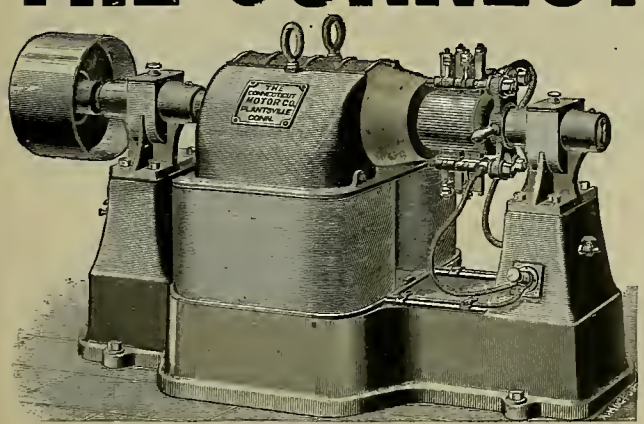

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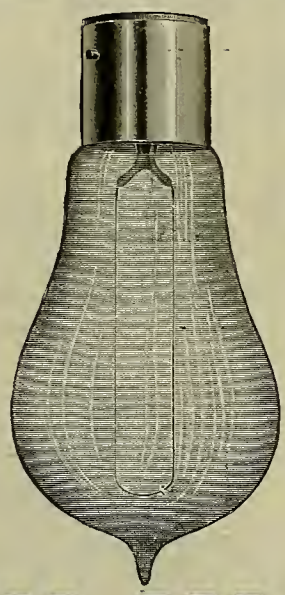

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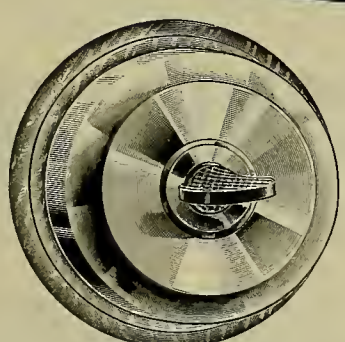

Paiste Switch.

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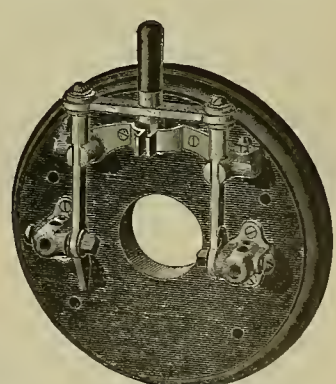

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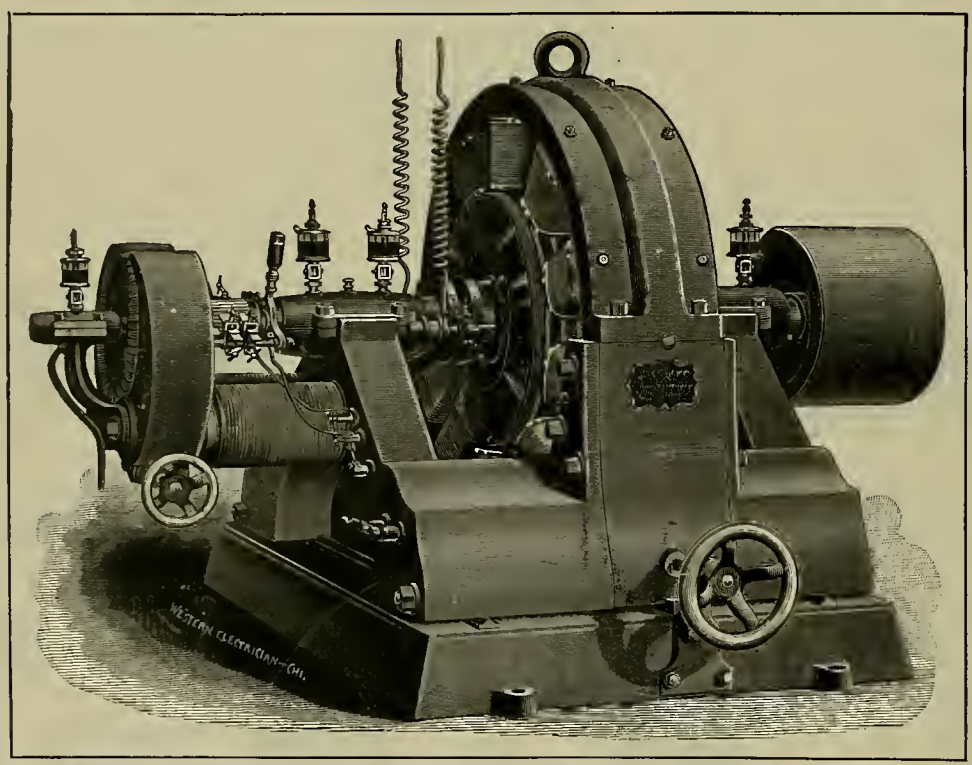

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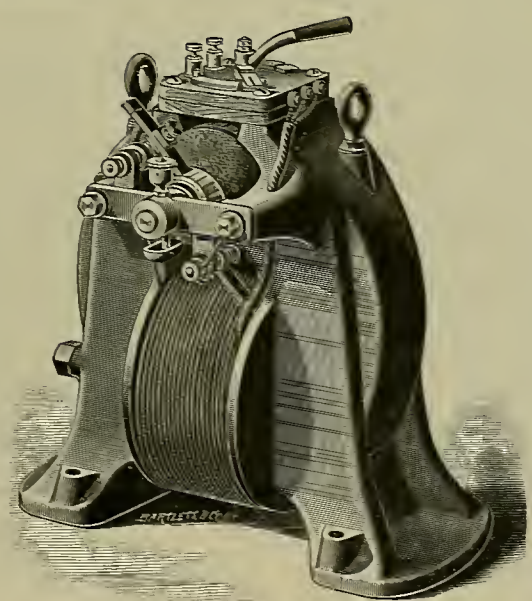

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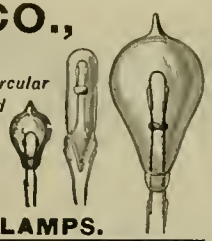

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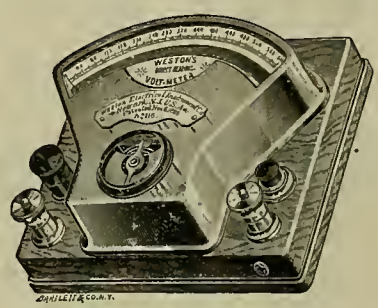

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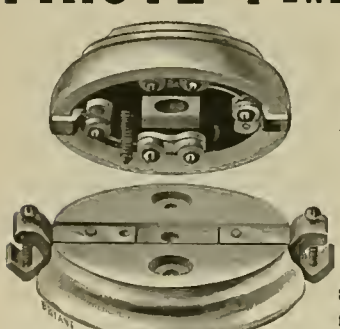

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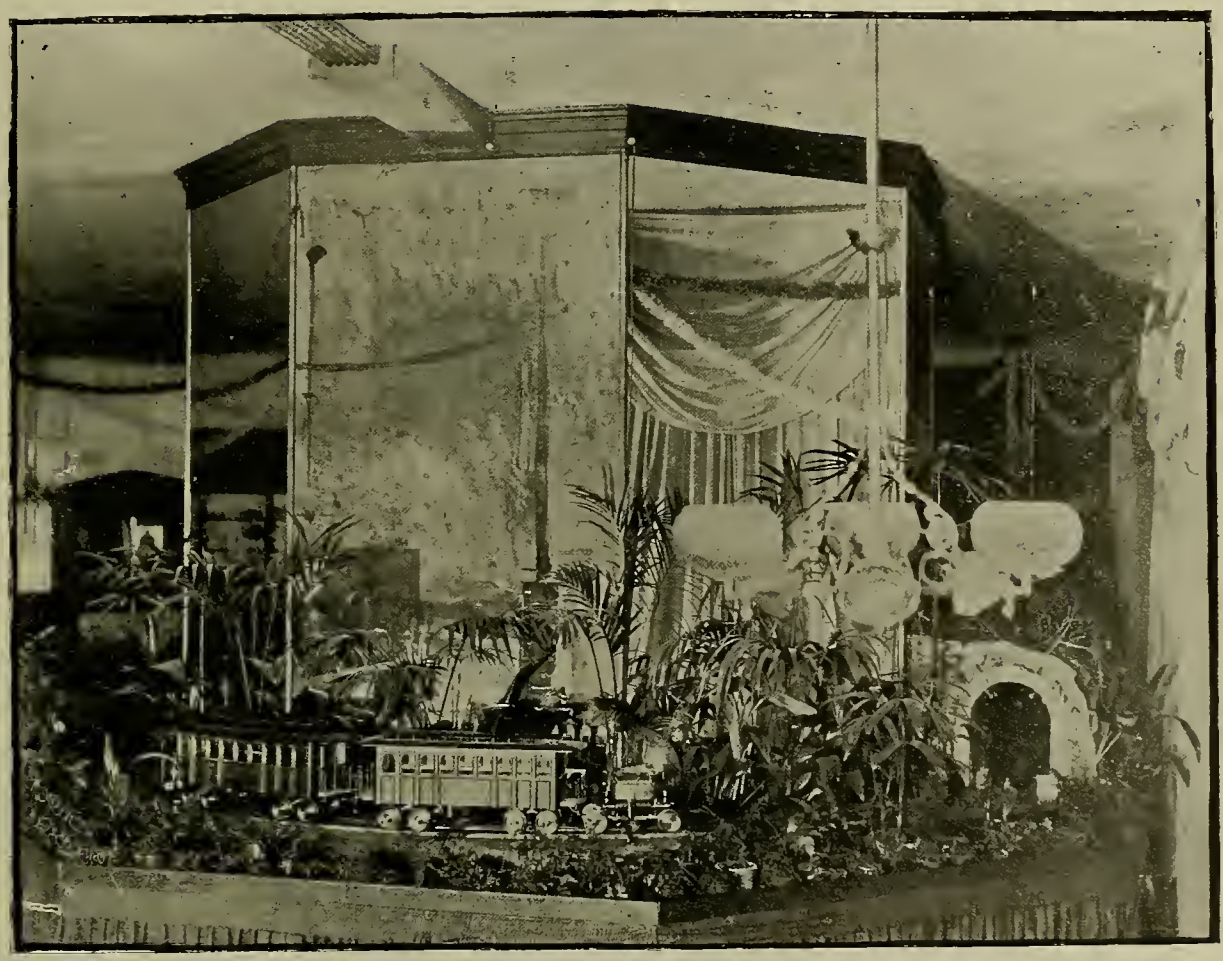
Miniature Electric Railway at the Lenox Lyceum Exhibit.

One of the most pleasing features of the electrical exhibition now being held at the Lenox Lyceum in New York is the miniature electric railway. As the visitor descends the steps which lead to the basement of the building his ears detect the tiny roar of a train speeding over the track at express speed. The track encircles an octagonal pillar, on whose mirrored sides are reflected the palms and ferns and moss-covered rocks, which increase the realistic effect of the arrangement.



MINIATURE ELECTRIC RAILWAY AT THE LENOX LYCEUM EXHIBIT.

The train consists of an electric locomotive and two cars, brilliantly lighted with bijou incandescent lamps, and as it scurries along in a brisk and business-like way it lights the signal lamps which are placed alongside the track, and extinguishes them as it passes by. In the same way a row of lights throughout the length of a tunnel shine out as the locomotive enters, and the departing train again leaves darkness behind it.

This beautiful model was designed by H. V. Parsell, a student of Stevens' Institute of Technology, for the purpose of illustrating the possibilities of electric train lighting and signaling, and the system is complete in every detail. A part of the construction work was executed at Mr. Parsell's private laboratory by C. W. Spicer. The cars were made and fitted by Bergmann & Co. The operating motor, which is one of the Perret type, with worm gear, is run at 110 volts, the tracks being used as conductors. Along the tracks, running parallel with the rails, are rods of brass, from which trail connecting brushes that light the small signal lamps which are placed along the track. One of the tracks is used as a return circuit for the storage battery current upon which the illumination of the lamps depends. In order to start the motor slowly, so that the whole force of the current may not be thrown on the worm, and thereby wrench it, the current is passed through a bank of lamps, and a uniform start can always be relied upon.

The public never seem to tire of watching this Lilliputian equipment as it forges its way round and round, continually appearing to make the "best time on record."

St. Louis City Electric Light System.

St. Louis has at last discontinued the use of gas as an illuminant for its main business thoroughfares and handsome residence districts, and substituted electricity. On May 1 the new plant supplying the city with electric lights began operations, and it has proved thoroughly satisfactory. There are now 1,613 arc lamps in operation on the streets of St. Louis in the district covered by the Metropolitan Electric Light and Power company. This corporation has a contract with the city for ten years, and the work of extending the system so as to take in all the streets and avenues of the Mound City will be continued. At present there are 492 miles of Simplex wire strung on 4,500 white cedar, 2,000 Norway pine and 500 cypress poles, furnished by C. H. Holmes & Co. The longest circuit is 18 miles, and has 57 lamps on it. The Wood lamp is in use. There are 39 dynamos of 60 lights' capacity, each furnishing the current for the city circuits. This station has already been described in detail in this paper.

The boiler house is at the west side of Johnson street, and the main building on the opposite side. These structures are connected by tunnel under the roadway. Both were constructed for the present plant, and are admirably adapted to its needs.

Electric Railways and the Census.

The census investigation of the general subject of transportation has been assigned to Prof. Henry C. Adams, statistician of the Inter-state Commerce commission. He has divided the subject into several sections, one of which is, "Rapid Transit in Cities." This section has been assigned to Charles H. Cooley, special agent.

The plan of investigation to be followed is to compare the several kinds of motive power now utilized, such as animal, steam dummy, cable and electricity, to show their relative economic value.

The schedules for the section of rapid transit in cities will include the inquiries to be made regarding electric railroads. That part of the schedules pertaining to the electrical branch of the subject will be prepared under the supervision of Allen R. Foote, special agent in charge of the department of electricity, and that portion of the report pertaining to the uses of electricity as a motive power for street cars will be embodied in his report on the investigation of the electrical industry, as well as in the report of the section making the investigation.

Mr. Cooley is anxious to have electric railroad men impressed by the fact that they can afford him great help by filling out and returning their schedules promptly.

Fort Wayne, Ind. Electric Club.

The Electric Club of Fort Wayne, Ind., although still in its infancy, is constantly growing in membership, and extending its influence. Its president, Charles C. Miller, announces that it "expects to do as good work as any organization of this kind can do." The club now has a membership of 150 and has secured comfortable club rooms. It is deserving the support of all who are interested in the dissemination of knowledge of electrical science, and the new club will undoubtedly receive ample encouragement and substantial assistance.

Chicago Telephone Company and Retail Druggists' Association.

A project is on foot to organize a company in Chicago to manufacture the D'Unger telephone, which has been fully explained in these columns. It is the intention of the projectors of the company to establish a competing telephone service in Chicago. The matter was discussed by the Chicago Druggists' association last week, and it is understood members of that association are interested in the project. The scheme is advocated by Dr. D'Unger, the "inventor" of the instrument. He holds out flattering inducements to investors and promises the druggists if they come in at once to admit them to the company on the ground floor. Some of the more conservative members expect by waiting they may be admitted via the basement or cellar.

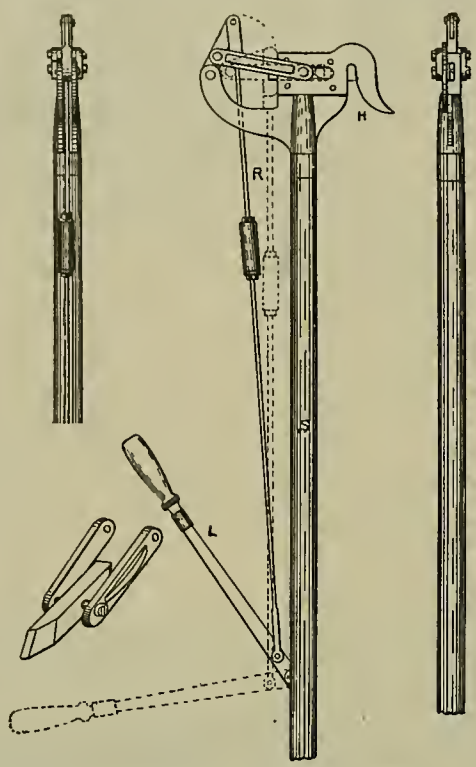
The Chicago Telephone company and the Druggists' association of that city agreed to disagree some time ago, and they have been conducting their respective affairs on this plan ever since. The Telephone company considers itself thoroughly competent to conduct its own affairs, and believes that as a public institution it is giving excellent service, and is deserving of the success it has enjoyed. It persists that it has a right to demand a reasonable return for the service which it gives the public, and believes itself best fitted to determine what is a reasonable compensation, as an acquaintance with the cost of plant, maintenance, etc., is necessary to make a fair estimate.

The dispensers of pills and tonics will not admit this. They have been fighting the Chicago Telephone company for a long time. They have not been very successful, however; they claim the contest has advanced their cause, but in what way and to what degree can only be discovered by the astute knights of the pestle and mortar.

It is not surprising then to see the druggists interesting themselves in this proposed company. It is not probable though, that they will be able to proceed with the scheme until they have engaged in a protracted legal fight, as the Bell company claims the D'Unger instrument infringes patents held by it, though long since discarded.

Tool for Cutting Electric Light Wires.

The accompanying cut illustrates an improved wire cutting device. It was designed by J. Knibbs of Troy, N. Y., with the object of providing an efficient form of tool to be used for cutting electric light, telegraph, or telephone wires where they are so strung from poles that they interfere with the operations of firemen working about burning buildings. The general construction of the tool will be understood after an inspection of the three different views presented in the cut. A slightly enlarged view of the cutting tool proper and its attached links is shown in the lower left-hand corner of the illustration.



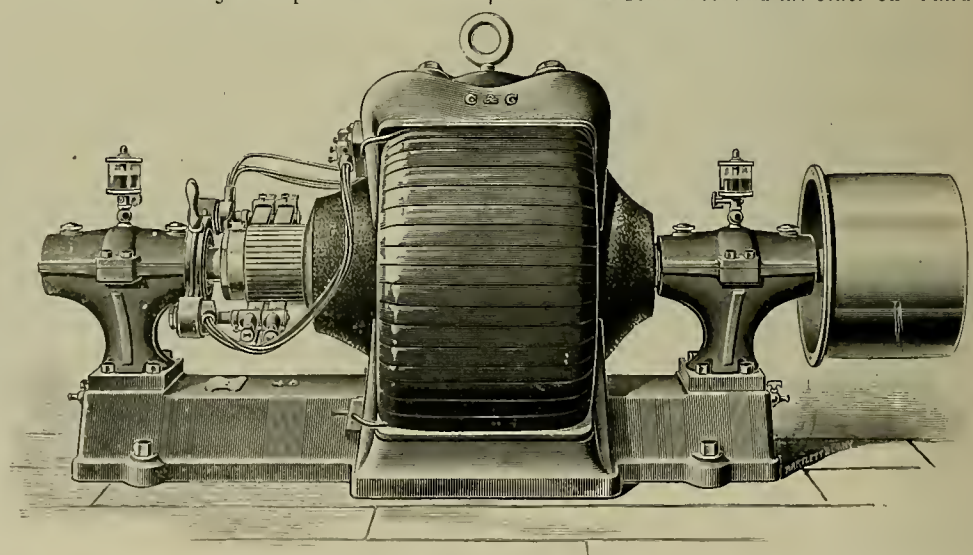
TOOL FOR CUTTING ELECTRIC LIGHT WIRES.

To operate the device it is hooked on over the wire or wires to be cut and so as to bring them within the jaws at the upper end. The handlever, *L*, is then pulled down into the position indicated by the dotted line and the cutter or blade, by the combined action of the rod *R*, the lever, *L*, and the links at the top, is forced outwardly to make a shear engagement with the face of the jaws, *H*. This action cuts off the wires. The rod, *R*, being insulated, as is the stem, *S*, fully protects the operator from the dangerous effect of an electric light current.

Twenty-Five Horse Power Motor.

The accompanying cut illustrates the latest form of the C. & C 25-horse power motor. The most striking feature of the machines is the shape of the magnetic circuit which forms a circle around the center of the armature shaft. This construction gives the shortest magnetic circuit; it is free from corners and projections where leakage may occur, and makes the motor compact for a given power.

The advantage of this form of construction is shown by the small amount of current absorbed by the several sizes when running either with or without load. The speed of the machine is 850 revolutions per minute.



TWENTY-FIVE HORSE POWER MOTOR.

Bright Outlook for Chicago.

The labor troubles which so recently threatened the prosperity of Chicago and promised seriously to retard all business operations have happily been settled, and the danger is for the present, at least, averted. The prospect has brightened considerably and there is every indication that the city is entering upon an era of prosperity surpassing anything in its history. The electrical industry, in conjunction with other departments of commercial activity, will enjoy great advantages, largely owing to the fact that Chicago has been selected as the site for the World's Fair. Electrical companies are especially interested in the building operations and the numerous immense commercial buildings and hotels which are now in view, will afford the electric lighting, wire and supply companies plenty of work. There is no doubt that the unusual activity displayed in the real estate and building market is largely due to the World's Fair. For instance, a number of huge hotels are contemplated on the South side, and all of these will, of course, be lighted by electricity.

Probably the finest hotel in the country will soon be in course of construction on the Peck property, Quincy, Dearborn and Van Buren streets, opposite the postoffice building. This hotel has already been described in this paper. E. A. Bachelder, of the Southern Hotel, and General Hascall, lesses, have concluded arrangements for the erection of a $500,000 hotel at Michigan avenue and Twenty-second street. The building will be ten stories high, and will occupy 100x161 feet. Arrangements are nearly complete for the erection of another fine hotel on Michigan avenue, between Harrison and Twelfth streets. It is to cost $250,000. The plans for the Hotel Metropole, Michigan avenue and Twenty-third street, call for one of the finest structures in the city. It will occupy 100 feet on Michigan avenue and 180 on Twenty-third street, six stories high and fire-proof. Ground has already been broken and the structure will be completed within a year. The cost will be $400,000. In apartment buildings there will be two modern structures erected on the South side, one at Indiana avenue and Eighteenth street, at a cost of $300,000, and another at Michigan avenue and Thirtieth street at a cost of $100,000. The plans for the South side office building, the Manhattan, have been finished. It is to be located on the east side of Dearborn, south of Van Buren. It will cover an area of 168x68 feet. There will be two fronts, one on Dearborn street and the other on Third avenue. It will be 204 feet in height, and will contain sixteen stories. The main entrance will be 50 feet wide with shafts of polished granite on each side. The architectural design will be beautiful. The interior will be elaborately finished. The cost of the structure will be $500,000.

These are but a few of the many buildings now under consideration in Chicago, but they will serve to show the activity in the real estate market and notify electrical concerns that the prospects for business in this field are remarkably good.

Safety of Ferranti Conductors.

An interesting experiment was recently tried with the Ferranti mains at Deptford, England. The London board of trade had put forward an objection that in case of a workman cutting the conductor the act would be dangerous to life. This was denied by the engineers, and the experiment was carried out to demonstrate that it was not the case. A length of the main was charged with the 10,000 volt current, and the main was then cut through with a hammer and a smith's set. This was done in front of the visitors, without the slightest effect upon the workman who held the tools. The main was of course short-circuited, and the fuse at the other end went, but otherwise there was no accident.

Cardew Grounding Device for Alternating Circuits.

The accompanying illustrations show the latest pattern of the Cardew earthing device as modified by Drake & Gorham, of London, and adopted by the London Electric Supply corporation. The action of the device is to connect the secondary circuit to ground automatically whenever a dangerous difference of potential is established between the lamp circuit and the earth. This result is obtained by interposing a medium which will be of infinite resistance until a dangerous difference of potential exists, when a free passage for the leakage current is provided.

In the Cardew device the static arrangement is adopted, as it is found to give the best results. This arrangement consists of two brass plates placed near but insulated from each other. Between these lies a thin foil of aluminium, which is retained in position by ebonite pegs, one plate being connected to earth and the other to the secondary circuit. A flat projection is formed on the upper plate over one end of the foil, so that as soon as a difference of 400 volts is established one end of the foil lifts by static attraction, and a metallic contact is made between the two plates. If there is a serious leak between the primary and secondary, and if the primary is also completely grounded elsewhere, the primary fuses in one or both of the houses in which the leaks occur are blown. These fuses will, of course, blow with a current too small to cause a fire. The plates are all made interchangeable, so that when the foil has acted it is merely necessary to slide in fresh plates.

It has been suggested that the permanent earthing of the secondary does all that the static contact will do. Grounding the middle of the

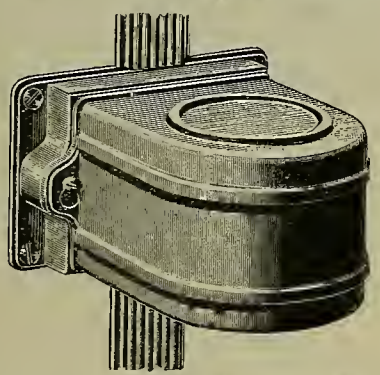


FIG. 1. CARDEW GROUNDING DEVICE FOR ALTERNATING CIRCUITS.

secondary circuit reduces the stress on the secondary insulation, but admits of danger from fire, as it only requires one leak to earth of the secondary to make a short circuit. With the static contact two are needed.

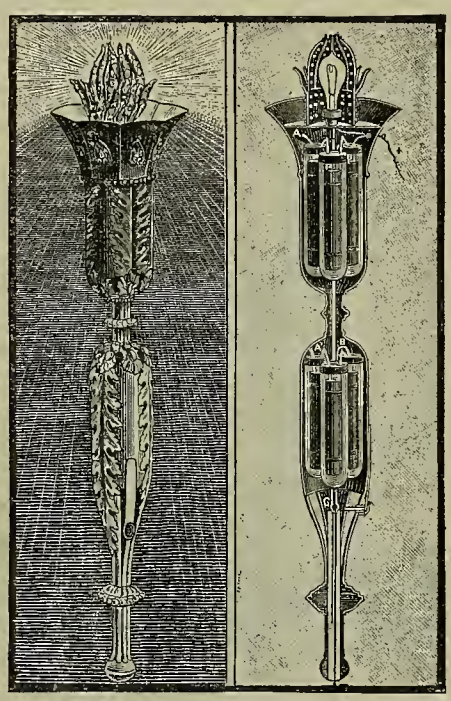
It is evident that the apparatus can be modified to cut off both poles of the circuit, or to ring a bell and drop a danger disk, as has been arranged for the Chelsea Electric Supply company, where continuous currents are used.

St. Louis Electric Railways.

The reports of the St. Louis street railway companies to the city registrar show why so many applications are made for franchises and for permission to substitute electricity for horses on the lines already established. Here are some figures taken from the official reports for the first quarter including January, February and March: People's Railway company, 39,574 trips, 693,355 persons; Arsenal Railway company, 32,940 trips, 211,623 passengers; Lindell Railway company, 107,014 trips, 1,175.094 passengers; Mound City Railway company, 43,954 trips, 518,240 passengers; Jefferson Avenue Railway company, 36,294 trips, 340,672 passengers; Union Depot Railway company, 79,732 trips, 1,194,155 passengers; Citizens' Railway company, 83,334 trips, 1,617,935 passengers; Northern Central, 41,702 trips, 490,022 passengers; Cass Avenue Railway company, 50,982 trips, 751,172 passengers; Union Railway company, 62,550 trips, 487,560 passengers; St. Louis Railway company, 58,582 trips, 1,695,080 passengers.

An Electric Torch.

In one of the brilliant scenes in the opera of "Ascanio" at the Grand Opera house, in Paris, Phœbus appears among the muses bearing the shining torch of Genius. The directors of the theater, in order to introduce a striking effect, determined to employ electric light to represent the burning of the torch. This result was accomplished by attaching to the upper part of the torch frame a small incandescent lamp concealed



ELECTRIC TORCH.

by stage jewels. As it was deemed inadvisable to employ long conductors, it was decided to use storage batteries for furnishing the current to the lamp. The general appearance of the torch, as it was finally planned and the disposition of the accumulators within its frame, are shown in the cut. Six cells are used, three are arranged in the upper part and three in the lower part of the torch. The plates are made of sheet lead, and each has a surface of 35 centimeters exposed to the electrolyte. The plates are immersed in slender glass containing tubes, as shown. The six cells have an output of three amperes at ten volts. A little push button at the right of the torch, at the point where it is grasped by the hand, serves to switch off or on the current, as desired. The cut is reproduced from *La Nature*.

Electrical Exhibit at the St. Louis Exposition.

The management of the annual exposition at St. Louis has decided to make a much more elaborate electrical display this year than heretofore, and already arrangements are making to secure exhibits from the leading electrical manufacturers of the country. The electrical display last year was in charge of Fred. H. Whipple of Detroit, and proved an attractive feature. Mr. Whipple has again been retained by the Exposition company, and has been given full power over the forthcoming exhibition so far as electrical apparatus is concerned. He is already at work and is now in communication with many projectors of new enterprises, which he hopes to have represented at the approaching exposition. He has profited by his experience in handling the display of last year. "It has been my aim," he says, "in securing exhibits this year to include as much as possible the electrical novelties, believing that the staples would be here any way. The multiplicity of the ways in which the electric current coupled with mechanical ingenuity can be brought to the service of mankind was never more forcibly demonstrated than to-day. It has been truly said that we live in an electric age. We do, and the thrill of eager wonderment and astonishment that permeates the public as these inventions tumble over each other in getting through the Patent Office is the effect I am seeking to produce in St. Louis this year. People are tolerably familiar with the electric light, they are learning more every day of electric railways, and I want now to direct their attention to domestic electricity."

One of the chief novelties which will interest the community will be the system of purifying water by electricity after the method of the Stanley Electric company of Philadelphia. This company, Mr. Whipple says, will have a plant at St. Louis capable of purifying many thousand gallons of water daily by electrolytic treatment. This will excite more than local interest, and representatives of cities in all parts of the country may be expected to witness the tests, as polluted water seems to be a prevailing evil in all large communities.

The progress that has been made in the application of electricity for heating purposes will interest the mechanic and housewife. Three companies that have been engaged in this special line will display their devices, each striving to outdo the other. It is claimed in this line that ordinary looking flat-irons to which flexible cord is attached may be operated continuously with no attention to anything but the work in hand. Soldering irons similarly connected can be used with no waste of time, by reason of putting them in the fire-pot to heat. Tea kettles, cooking dishes, tin pans and all the innumerable culinary articles may be placed anywhere and their contents brought to a boil or well baked in the time ordinarily taken in lighting a fire. Another company will exhibit heating coils, which look like the average steam radiator. They can be placed anywhere and the atmosphere warmed by the hidden current. Improvements in street car heaters will also be shown. There will be talking dolls, electric exercising machines, danger signals, electric valves, temperature controllers, etc.

Joseph Irwin, of Topeka, Kan., has promised to make an interesting exhibition in the form of a double track railroad, 60 feet long, with two moving trains, between which telegraph dispatches will be sent. In this exhibition it will be explained how the engineer of one train can

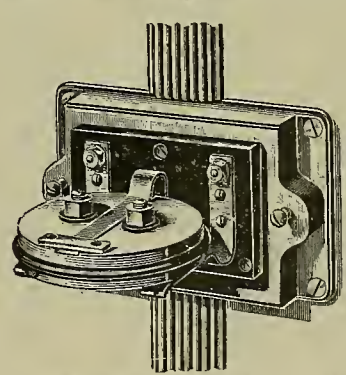


FIG. 2. CARDEW GROUNDING DEVICE FOR ALTERNATING CIRCUITS.

communicate with the engineer of a train two miles ahead or behind, while both trains are going at the ordinary speed. Mr. Irwin will also show his code of war signaling by electricity.

Already the Westinghouse Electric company has applied for a large space in which to erect an immense power plant for electric lights, motors and a street railway. The railway cars will be operated by alternating motors, it is promised.

A storage battery car will be operated by the Electrical Accumulator company of New York.

Several types of motors for mining, drilling, etc., will be shown, and there will be the usual display of dynamos, motors and machinery with which the general public is now fairly familiar. Mr. Whipple says: "Gold, silver and bronze medals will be awarded upon all classes of elec-

trical appliances, and a great many firms are entering their products. The committee on awards will be composed of three leading scientists and practical electrical engineers. The American Institute of Electrical Engineers has, at my invitation, appointed Carl Hering of Philadelphia, who was one of the judges at the last Paris Exposition. A similar invitation was extended to the National Electric Light association, and at its last convention E. R. Weeks, of Kansas City, Mo., the retiring president of the association, was appointed. For the third member I adopted the plan of having the entire electrical interests vote for a choice, and the result will not be known until July. President Kennard of the exposition has entered into the electrical work with his usual vim, and he has said he desired to prepare a series of electrical tableaux and representations on the Music Hall stage, which certain evenings would be set aside to produce. It is needless to say that I shall act on his suggestion to the extent of my ability. Altogether, I can promise you something you have never seen."

Electric Motor.

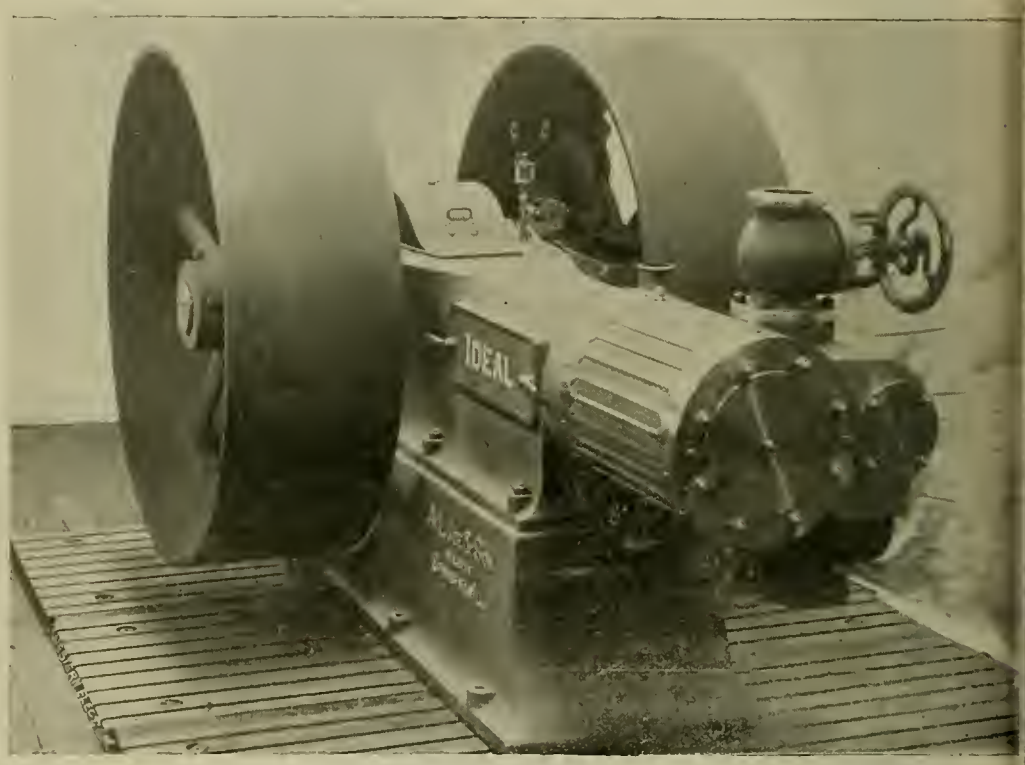
By Forbe Bain.

A device for transforming electric power into mechanical power, in its broadest construction, is an electric motor. Although we are congratulating ourselves that we are now living in an age of great improvement, discovery and advancement, it is perhaps not generally known that the electric motor which seems essentially a creation of to-day, is much older in its origin than the steam engine. We are told that Hero of Alexandria in the *Pneumatica* 130 years before Christ mentions and describes two devices, by which the heat energy of steam was converted into mechanical motion. From their nature we must consider these devices as forms of the steam engine. In a form about as crude we can trace the existence of the electric motor to remote ages for, "in the sixty-fourth year of the reign of Ho-ang-ti (2634 B. C.) the emperor Hiuan-yuan, or Ho-ang-ti attacked one Tchi-yeon on the plains Tchou-lon, and finding his army embarrassed by a thick fog raised by the enemy, constructed a chariot (Tchi-nau) for indicating the south, so as to distinguish the four cardinal points. * * * etc." (Klaproth Lettre a. M. le Baron Humboldt sur l'invention de la boussole.)

This "chariot" was what we call a compass, and a compass is unquestionably a device by which electric power *may be* converted into mechanical power, or in other words, an electric motor. In our earlier school philosophies we were taught that the direction of the needle of the compass was determined by a large magnet or loadstone situated somewhere in or near the north pole. In this case the compass would be a magnetic motor, and not an electric motor. We know now however, that the directive force of the compass is due directly to earth currents of electricity, and indirectly to the polarization of the earth as a whole, and that electric currents acting upon the magnet of the compass give it the power of motion. It is indeed a primitive motor; its efficiency is not high, and it would be a difficult task to make a curve of its counter electromotive force, one thing at least may be said in its favor; it does not spark at the commutator.

The ancients noticed that lightning affected it, "threw it into great distress," and thinking that this disturbance was a manifestation of the displeasure of some of the gods, the emperor immediately caused to be decapitated various numbers of his benighted subjects, the quota no doubt varying in proportion to the "distress" of the compass. Who knows but that some ambitious Guy Fawkes who wishes to obtain cheap notoriety may, even in our day and generation, adapt the electric motor to some capital punishment device as has been done with the alternating dynamo? As we are living in times of keen competition, this may serve as a "pointer."

The references cited in the case of the steam engine or the electric motor can hardly be considered apt anticipations of the modern wonders of perfection. These latter are the outgrowth of the generic germs that we have described, but the *strain* has been so greatly improved within the past few years, that it may be fairly said the creations belong to the present day. The modern electric motor in age is as an infant to a patriarch, when compared to the modern steam engine. As a means for transforming energy the electric motor has reached as near the acme of perfection as it is possible to attain in any way or by any means. If the steam engine was as nearly perfect in converting the potential energy of coal into power as the electric motor is in transforming electricity into power, then we could produce about six times as much light with a given amount of coal as we are now able to do. A modern steam engine requires, say 2½ lbs. of coal per horse power hour. This consumption now produces 192 incandescent candle power hours. If the steam engine was as perfect a transformer of energy as the electric motor or dynamo, then in round numbers 2½ pounds of coal would produce, say 1152 candle power hours or about 72 16-candle power incandescent lights at a cost in coal and water of one horse power, at present. Going another step farther, if we could convert the potential energy of coal into light without first converting it into so many transitions of force as heat and light, power, electricity and heat, then 2½ lbs. of coal would maintain about 200 16-candle power lights or 3,200 candle power hours instead of 192 candle power hours.



IDEAL ENGINES IN CHICAGO CITY ELECTRIC LIGHT PLANT.

Ideal Engines in Chicago City Electric Light Plant.

The accompanying illustration shows the general design of the twelve Ideal engines recently installed by A. L. Ide & Son, of Springfield, Ill., in the new city electric light plants in Chicago. These engines have each a capacity of 125-horse power, with a 14x14 cylinder. The pulleys, it will be noticed, are of unusual width. Each has a face 22 inches in width and is 66 inches in diameter. Two dynamos are belted to each fly wheel, consequently one engine supplies power to four machines. In perfecting this engine it was the intention of the builders to produce a machine which would meet successfully the special requirements found in driving electric light and power plants, where perfect regulation should be combined in limited space, and at the same time furnish a reliable and economical power.

This engine is notable for its double frame, making it doubly rigid with double cranks and shaft bearings. The main shaft, crank pin, connecting rod, piston rods and governor parts are all of high grade steel, and the cross-head is a crucible steel casting, with removable hardened steel pin and cross-head slides. The stuffing boxes and glands are phosphor-bronze. The guides are of liberal width, and are cylindrical. The castings of the bed plate and other parts are made of best charcoal iron, heavy, and well braced. The engine is shown mounted upon heavy cast iron sub-base, or what is commonly called "foundation box," upon which it is tested in the works by running with brake and indicator. This base reduces considerably the cost of foundation.

One of the special features of the Ideal engine is the self-lubrication of every working part of the engine. The engine literally runs in oil, splashing being prevented, as indicated, by a casing around the working parts. The oil channels are large, and the flow of oil over all the bearings is positive. No oil is wasted or thrown upon floors, but is returned to the oil chamber to be used over again by being withdrawn and filtered. In the place of ten or twelve oil cups, found upon most engines, each of which must be carefully watched to keep the oil feeding drop by drop, this engine has but one oil receptacle, from which all the oil is automatically delivered in streams to all parts of the engine requiring lubrication. It is claimed that there never has been an instance of an Ideal engine stopping from hot bearings. The working parts are as accessible as in any center crank engine without removing bolts or nuts.

The range of cut-off is wide, and enables the engine to carry a load largely in excess of the rated power.

Ferranti's Work Not a Failure.

There appears to be a difference of opinion among the English journals as to the seriousness of the trouble with Ferranti's high tension system in London. The following from the London *Electrical Engineer* would seem to indicate that this colossal enterprise is not such a great failure after all:

Further reports, says our contemporary, of the failure, past, present or future, of the Deptford station continue to be rumored, and we suppose, will until the station is entirely opened. As a matter of fact, the Deptford station is working now, and has been working practically every day since November last, supplying current for the Grosvenor circuit—at half pressure, but usually full current—Deptford working as a reserve to the Grosvenor plant. A second engine is now erected, and sundry small improvements are being introduced into the second dynamo before starting. The reports of the failure of the Ferranti mains are devoid of any foundation. Recently a length of main, consisting of some 30 or 40 lengths, and extending round the Deptford station, was tested with transformers up to 18,900 volts without failure. The mains are considered quite satisfactory, and tons of the lengths are being manufactured. Some miles are already laid along the route in different parts. Although more time has been taken than has been expected, yet it is sufficiently noteworthy that, with the ex-

ception of inclosing the mains to satisfy certain authorities, the work at Deptford has all been carried out as originally proposed and determined, and the engineers avow themselves thoroughly satisfied with the result, both of the dynamos and the mains.

Signaling across Rivers in India.[1]

By W. F. Melhuish.

It not unfrequently happens that a river cable fails entirely, or becomes imperfect at a time when, owing to the force of the stream, a new cable cannot be immediately laid, or when there is no ready-made cable available, or when a considerable period must elapse before the new cable can reach the river. To provide for these contingencies attempts have from time to time been made in India to signal across rivers without cables. Three different methods appear to have been discussed and attempted, viz: 1. Sig-

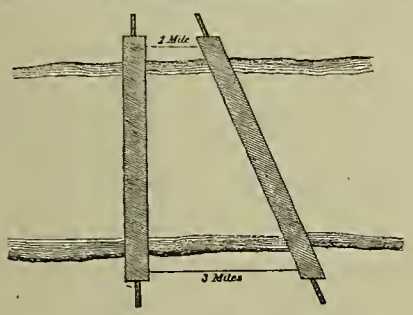


FIG. 1. SIGNALING ACROSS RIVERS IN INDIA.

naling through an imperfectly insulated wire. 2. Signaling through an ordinary bare wire. 3. Signaling without any metallic conductor.

During May, June and July of the year 1888 Mr. Johnston made a long series of trials across the canal and the river Hooghly, and the subsequent measurements and experiments led him to come to the following conclusions, viz.: That up to 1½ miles it is perfectly easy and practicable to signal through a bare wire under water; that for greater distances, judging from experiments, it is not possible to signal in this manner. In April, 1889, W. P. Johnston died, and the duties of electrician were intrusted to me. I resolved to change the class of signaling apparatus, and to continue the experiment. Discarding continuous steady currents and polarized receiving relays, I adopted Cardew's vibrating sounder. I began from the beginning, and tried to signal across a waterway without a metallic conductor by laying down two earth plates on each of its opposite banks. Readable signals having been exchanged, the distance separating each pair of plates was varied with the view of ascertaining how close the plates might be brought together, the signals remaining still readable. Readable signals were exchaoged when the distance separating the plates was equal to the breadth of the river, reading becoming more difficult as the plates were made to approach each other, and clearer and more distinct as the distance between the plates was made to exceed the breadth of the river. I learnt from these experiments that in order to obtain signals of sufficient distinctness for the practical purpose of transmitting messages, it would be necessary to construct a line on each bank of a river much longer than the breadth of the river; and as the rivers along the coasts in India are extremely wide, I became impressed with the impracticable character of such an undertaking, and decided to strike out on a new line. This new line was the laying of two bare uninsulated iron wires across the waterway parallel to each other, and separated by a certain distance, the ends on each bank being looped together by means of an insulated conductor. Hence, though much of the circuit was laid under water, it was nevertheless a continuous metallic circuit. Beginning first with a complete square by laying the wires as many yards apart as the river was wide, signals were instantly exchanged that were incomparably louder than those that were exchanged when the same area was bounded by four earth-plates. The length of each of the two wires under water was next gradually increased to 740 yards, and the distance separating them gradually diminished to 35 yards, the strength of the signals diminishing proportionately, and ceasing to be readable when the wires were further prolonged. The conclusion arrived at from these experiments was that for the practical and useful purpose of signaling messages across a broad river in the absence of an insulated cable, a complete metallic circuit was at least desirable. Acting on this conclusion, it was sought to apply it practically, and the following experiment was carried out: At a distance of 15 miles west of Calcutta a cable is laid across the river Hooghly, which at this point is 900 yards wide. The iron guards of this cable were employed to form one of the metallic conductors, and at a distance of 450 yards down stream a single wire, weighing 900lbs. per mile, was laid across the river to form the second metallic conductor, insulated land lines having been run up to loop the two parallel conductors together. The experiment was quite a success, the signals being readable without difficulty.

A number of other experiments were made as follows: The local line from the central office, Calcutta, to Garden Reach is about four miles in length, and at about midway the wire spans a small river. Vibrating sounders having been put in circuit at each end of this line, the wire where it crosses the river was taken down and laid along the bed of the waterway. Signals were loud and clear at both ends. From the success of this experiment it may be inferred that on any ordinary line, should the wire from accidental causes come off the insulator and make earth by touching the bracket, standard or ground, or should the wire break and both ends of it be lying on the ground or in a watercourse, communication could still be maintained by means of the vibrating sounders.

The line wire which connects the town of Chandernagore with Barrackpore is about 10½ miles long, 900 yards of which consists of a cable laid across the river Hooghly. Vibrating sounders having been joined up in the telegraph offices at Barrackpore and Chandernagore, the insulated conductor of the cable was thrown out of circuit, and the line wire on each side of the river was joined to the iron guards of the cable; thus for a length of half a mile out of 10½ miles the conductor was wholly under water, yet it was found quite feasible to transmit messages between the two offices. From the success of this experiment it may be reasonably inferred that in the case of certain cable crossings where the rivers are not too wide, should the copper conductor of the cable make dead earth or become insulated by parting, communication could still be kept up between the two offices on either side.

The terminus of the Northern Bengal State railway at Sara is separated from that of the Eastern Bengal State railway at Damukdia by the river Ganges. The opposite banks of the river in this locality are connected by two independent cable crossings. The length of one of these crossings is 1 mile 610 yards, and of the other 4 miles. The distance which separates the two cable houses on the Damukdia side is 3 miles, 1,584 yards, and on the Sara side the cable houses are only 1 mile 211 yards apart, giving a mean lateral distance in alignment of 2 miles 880 yards.

The two cable houses on each bank of the river have an insulated connecting land line. The two cable crossings and the connecting land lines form an irregular metallic circuit somewhat resembling that given in Fig. 1.

The connecting land lines having been joined to the iron guards of the cables, two vibrating sounders were placed in circuit, one on each side of the river, when signals so strong were transmitted across that it was not difficult to read them at a distance of 6 feet away from the receiving telephone.

From the marked success of this experiment it may be inferred that at all river cable crossings where the cables are laid in separate alignments (and the farther apart the better), should the cables become interrupted, communication may still be maintained from bank to bank by using vibrating sounders, thus avoiding the delay, inconvenience and cost of a boat service.

It should also be remembered in the case of such a parallel cable crossing, that besides the circuits afforded by the copper conductors when these are in working order, there is always an additional local circuit available by means of the iron guards between the opposite cable houses, and that this circuit should be used by means of the vibrating sounders as a talking circuit, in cases of necessity, without interrupting through working on either of the cables.

Each of these three experiments may properly be described as a delicate experiment. With so much of the conductor under water, the quantity of current which reaches the receiving telephone is so infinitesimal that signals could not be successfully transmitted if the vibrator were joined up in the ordinary manner. It is desirable in circumstances similar to these to reduce all the resistance external to the actual connecting lines to as small a quantity as possible, and, therefore, when messages are being transmitted, the telephone at the sending end should be removed from the circuit, so also should the vibrator from the receiving end. To effect this two-fold purpose, a special form of signaling key, designed by the writer, is requisite. This key, together with the complete set of connections for a parallel cable crossing, is shown in Fig. 2.

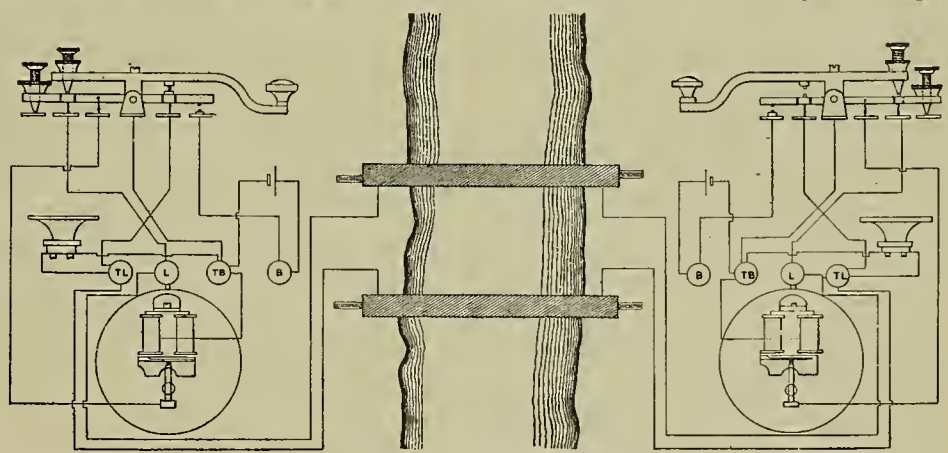


FIG. 2. SIGNALING ACROSS RIVERS IN INDIA.

[1] Abstract of a paper read before the London Institution of Electrical Engineers.

Patton Motor Car.

In the description of the Patton motor car which was illustrated last week in the Western Electrician it should have been stated that the motor car was 23 feet 6 inches in length, and was carried on a single truck as shown in the cut. The private car of George M. Pullman, which was attached to the motor car on the trial trip at the Pullman works, is 36 feet long and is an 8-wheel car.

The new city hall at St. Louis will soon be in course of construction. One of the features of the new building will be an elaborate electrical plant.

The Diathermancy of Air in Relation to the Efficiency of Incandescent Lamps.[1]

By F. Higgins.

It is occasionally useful to know something of the state, of the vacuum in incandescent lamps without injuring them by perforating the bulb with electric discharges.

The property which air possesses of transmitting radiant heat in proportion to its density, affords a means for obtaining this information.

I have not seen any mention of this property in works on the subject which I have consulted, and do not know whether my results agree with others which may have been obtained.

In order to make some comparative tests, I obtained, through the kindness of Major Flood-Page, a number of lamp bulbs, fitted with similar filaments of platinum iridium, as nearly as possible alike in length.

Some of these bulbs were exhausted to the highest possible degree, some left open to the air, and others exhausted to a pressure equal to 1-10th inch of mercury.

With a sensitive thermoscope the different qualifications of the three descriptions can be made apparent.

The lamps of each class being very similar in their behavior, it is only necessary to give the results obtained with one of each type.

The highest possible exhaustion is that which is supposed to be the condition of the electric lighting bulbs; the 1-10th inch gives a vacuum like that necessary for the Geissler tubes; the air bulb, as before mentioned, open to the air.

By means of adjustable resistances and batteries the three lamps were brought to the same degree of red heat, as nearly as could be judged.

The potential at the filament terminals and the volume of current flowing were measured in each case, with the result that the air bulb required, to produce the red heat, 7.02 watts; the 1-10th inch vacuum, 5.336 watts; and the highest possible .646 watts only.

With the same lamps in series the highest possible becomes white hot with a current which scarcely causes visible redness in the air bulb filament, and only dull redness in the 1-10th inch vacuum.

The relative conductibility of the three bulbs, as measured by radiation upon a sensitive thermoscope, was—

Air, 325deg.
1-10th inch vacuum, 250deg.
Highest possible, 35deg.

When the same filaments were raised to incandescence, that in the air bulb required 31.2 watts per candle, the 1-10th vacuum, 15.20 watts per candle, and the highest possible vacuum, 4 watts only per candle.

These results show that of two similar lamps one, merely from imperfect vacuum, may require double the current that is necessary in the other to produce the same amount of light, and at the same time become dangerously hot. The two extremes of my scale show, for example, the absorption of nearly eight times the force in the case of the air bulb that is necessary to produce the same effect in the most efficient lamp with a higher vacuum.

It is possible that vacua produced by chemical absorption of carbonic gas may be more perfect even than this, and advantageous to use. There is always some air left in a vacuum produced by a pump; but it is possible to imagine that no gas will be left unabsorbed in the case of caustic potash and carbonic acid gas being employed.

Lamps which differ much in the state of their surrounding medium differ also in their behavior when current is applied. Those which have a very perfect vacuum attain incandescence slowly, and lose it in the same way; while those which are imperfect start suddenly into incandescence, and as suddenly lose it.

The Prospect Park dummy line of Memphis, Tenn., will be ready for the electric motors by the time the new electric light and power plant is completed, if the work goes steadily on. Beginning at McLemore and extending along Rayburn toward the city to Walker avenue, rails and ties are on the ground, and the poles for the wires are all up.

Capt. Hall, of Fort Clark Railway company, has decided to put in an electric railway plant immediately on the granting of the franchise by the city of Peoria, Ill., which franchise is now pending, and will probably be put on its passage at the next meeting of the city council.

[1] Paper read at the London Institution of Electrical Engineers.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE attorney-general of Massachusetts is a determined opponent of municipal control of lighting plants. As stated in our Boston letter, he has recently given it as his opinion that cities in the Bay state have not only no right to sell the electric current, but that they are not authorized to establish lighting stations for their own use. His views are very much in accord with those of "Municipal," expressed in an article in last week's issue.

"A PLEA for the Unappreciated" is the heading of a short article, presented in this issue. The writer calls attention to the fact that there exists in almost all companies exploiting electric systems, a department which, too often, receives little recognition. The expert department, he thinks, is deserving of greater appreciation. While the article is evidently written from the standpoint of one who has himself played the part of "trouble man," and hence is perhaps a little biased, it calls to mind certain facts which are sometimes forgotten. Those who were pioneers can appreciate, as they look back, the innumerable difficulties which once beset the expert. To be sure, a different state of affairs exist to-day; still credit should not be withheld where it is due.

THE first practical step toward burying electric wires in St. Louis has been taken, and it is noticeable that the movement is voluntary on the part of the company whose wires will be put underground. The Postal Telegraph company has asked for a franchise to construct a conduit, and it is probable permission will be granted. The local manager of the company is reported as saying that telegraph companies will soon be obliged to bury their wires. He believes that the reduction of expenses in operation will fully compensate the company for the expense involved in burying its wires.

ONE resolution adopted by the American Meteorological society which met at Washington recently, is of particular interest to American electricians. Prof. Mendenhall moved that it be the expression of the opinion of the society that, inasmuch as the electrical units have received the names of distinguished specialists from all parts of the world, excepting America, one or two of the units yet to be designated should have the name Franklin, Henry, or both. The matter is likely to be brought definitely before the International Electrical Congress during the session to be held in this country in 1892.

LAST week saw another advance in the price of rubber of which manufacturers of insulated wire learned with interest. It was announced a few days ago that a purchase of 2,000,000 pounds of rubber, amounting to $1,550.000, had been made by a few large manufacturers who must have rubber to run their factories regardless of price. The holders of the balance of the stock it is stated have now raised their prices five cents per pound, and even a further advance is predicted. The total available stock of all kinds of rubber in the world is said to be 3,010 tons, against 7,708 tons the same time last year.

AUSTRALIA has long been considered an inviting field for enterprising electrical companies, and reports from that country confirm the good impression already prevailing in this country. Electric lighting has made but little progress comparatively in Australia as was shown in an article by Charles Flesch in the WESTERN ELECTRICIAN, Aug. 24, 1889. The prospect at that time were excellent, he said, in all departments of electrical activity, and the experience of operators during the last six months corroborates these statements. In another place in this issue is presented an article by E. J. Erskine in which he dwells on the recent activity in electrical circles in Australia.

THE question whether electric light companies are manufacturing concerns has again been considered by a Pennsylvania court. A summary of the decision is given in the Pittsburg letter, in this issue. The case is of special interest to all electric illuminating companies in Pennsylvania, inasmuch as a state law makes manufacturing corporations exempt from taxation. The conclusion of the court is identical with that reached by a Pennsylvania court a year ago. It is held that the term manufacture can be applied only to a material product. Naturally enough Pennsylvania companies think that this distinction is rather arbitrary, though it must be confessed that the decision is unquestionably correct, if Webster's definition of the word manufacture is to be accepted, that is, "to make or fabricate from raw materials by hand, by art or machinery and work into forms convenient for use."

A GLANCE over a few of the Parisian technical journals reveals the gratifying fact that they are all thoroughly interested in the World's Fair, to be held in 1893. *La Nature* has commenced a series of extremely entertaining articles describing points of interest in Chicago, and in connection are presented several accurate views of principal streets and buildings. The really significant fact which strikes one in perusing the article, is that its writer views the location with favor, and is not frightened at its distance from the seaboard. The articles which have thus far appeared have described Chicago in a favorable, not to say, flattering way. *La Nature* closes its first article with the remark that, "The most interesting object of the Chicago Exposition will be Chicago." *L'Electricite* of Paris, in the introduction to an article on the World's Fair, says: "The adoption of the bill which gave to Chicago the Universal Exposition of 1893 was the signal for a burst of intellectual activity in this city." "The burst of activity" expended itself in a struggle to win the prizes offered by a journal as rewards for the three best projects for making the Chicago World's Fair noteworthy. Two of the proposals which have thus far been submitted contemplate the use of electricity. One inventor proposes to build out into the waters of the lake a sort of tunnel made of thick glass. Electric light would be used on an extensive scale, so that the waters on all sides of the tunnel would be illuminated for a considerable distance. The inventor says the effect would be similar to gazing into an immense aquarium, though infinitely more beautiful. We rather fear, however, that too few fish venture near the city of Chicago to make the tunnel an interesting place to study the habits of the denizens of the lake. Another inventor proposes the construction of two towers, each about 400 feet high, at a considerable distance apart. He suggests that between the two heights an ærial electric railway be built. It is stated that an ærial road of this character is to be built between two hills, about a quarter of a mile apart, at Zurich. These allusions to the fair are significant, as tending to contradict the reports of eastern papers that European countries are not interested in the international exposition.

IN the last issue of the WESTERN ELECTRICIAN the announcement was made that a writ of habeas corpus had been issued upon the application of counsel for Kemmler, which acted as a stay in the execution of the death sentence of that unfortunate wretch. The writ was granted by a United States court upon the ground that the application of electricity as a means of inflicting the death penalty was illegal under that amendment of the federal constitution which provides that cruel and unusual punishments shall not be inflicted. This is the same ground upon which the fight was made in the New York courts. The provisions of the state and national constitutions in regard to punishment are identical. It is understood that the habeas corpus granted by Judge Wallace of the United States Circuit court was issued upon the distinct understanding that it was to be operative only until an application could be made to the United States Supreme court for a similar writ. On Monday last the latter court refused a motion for a writ, but consented to hear an argument for a writ of error at a subsequent time. There is no probability that the law will be found unconstitutional, however much we may wish that a federal court would so regard it. The law has been before three courts in New York state and in each case its constitutionality has been affirmed. The United States courts will have no new points to consider apparently, inasmuch as the provision of the national constitution in regard to punishment is substantially the same as that of the New York constitution as we have already stated. It is a fact worthy of comment that a change of sentiment concerning electrical executions has occurred within the last year. When it was proposed, the new law was considered as an evidence of advance in human civilization. That such is not the prevailing idea at the present time is shown by a number of newspaper opinions quoted in another column. There were advocates of electrical execution in several states a year ago. They are very quiet just at present. Legislatures no longer seem in a hurry to follow New York's example in passing laws substituting a new means of inflicting death in capital cases, but are content to await the result of the experiment in the Empire state. If there is as pronounced a change of public opinion in New York state in regard to electrical execution as there has been elsewhere, the legislature will be forced to erase the obnoxious measure from the statute books.

A Plea for the Unappreciated.

By Practique.

If we may be allowed to imitate Bellamy, and for a moment glance back over what is now too generally referred to as the "phenomenal progress of the electrical industries," it must be admitted that the word "phenomenal," though hackneyed, is well used. A number of electrical industries have, indeed, advanced with the most marvelous rapidity, until to-day there is invested in this field almost unlimited capital.

Reverting to the time when the electric light formed merely an interesting laboratory experiment and the electric motor a scientific toy—a time we can all remember—and comparing the advancement made in this line with that accomplished in other fields of industry, our conservative business man naturally wonders how such great results were brought about in so short a time. To him the policy of the successful firms constitutes an interesting study. In the immense factories working to full capacity is found evidence of the fact that good management will effect wonders, but a glance about us brings also a realization that the magic word "electric" is not always synonymous with wealth. If our business man be a manufacturer himself, but not in this particular field, and possessed perhaps of some knowledge of engineering, he soon learns that success in the exploiture of an electric system is not necessarily or wholly dependent upon the superiority of that one system over others. Should he be of an investigating turn of mind, he will, in all probability, discover that for all practical purposes, two systems may be equally good, electrically and mechanically, yet one from a commercial standpoint be a failure, while the other is successful. Naturally then, success is attributed to good business management, and as a consequence, there arises a curiosity as to the policy pursued by the most flourishing companies.

A close study of the manner in which the business is carried on, and a careful consideration of details of the management, will reveal to the uninitiated that there exists one department in every electric company which, although most important in its relation to the successful and extensive introduction of that particular system, is as a rule unappreciated. I refer to the expert department which is now such a necessary adjunct to every electrical company.

Not many years ago when our electricians were men who handled currents measured in milliamperes, the name "expert" signified little. In many cases the expert's chief qualification for his work consisted in an ability to persevere. In other words, the expert of those days was only too often of the "try and see" kind, and although, perhaps, a good workman as far as skilled fingers were concerned, was in nine cases out of ten a man who was at a loss when compelled to exert himself mentally. Now all this is changed. The skillful handler of heavy currents and high voltages does but little trying until he has done considerable thinking. To-day we find as experts in our leading companies, men of education, and in many cases graduates of our colleges. But with all this, we find that scanty recognition is accorded to the experts, comparatively speaking. We learn of the sale of a large lighting plant, or of the equipment with electric power of an extensive street railway system. The public reads the accounts of the "persistent efforts of Agent H. T. Blank, who has equipped such and such a road," or "started a lighting plant in the city of so and so." Little thought, as a rule, is given to that humble representative of the electric company, who follows Agent Blank, but in how many cases does the success of the sale depend upon this one man? Agent Blank goes on his way rejoicing, the installation turns out to be a brilliant success, the company collects its bill without delay, and—Agent Blank is a great man—so the papers say. But where is the expert, and what has he done? True, the company appreciates his services, but on the outside little credit is given where, at least, half is due. A visit to the factory of one of our successful electrical companies will reveal the extent to which the expert department is fostered. Managers, as a rule, now recognize that it is one thing to sell apparatus, and another to make it run. They have been forced to realize that an agent's representation as to the performance of apparatus must be substantiated. They must look to their experts to fulfill the guarantees. In the pioneer days of the business when experts were "green," and agents still "greener," how often was our young engineer deputed to perform impossible feats in electrical engineering! Many a story of tribulation could be traced directly to an imaginative agent's failure to realize that the man who follows will in most cases be called upon to demonstrate the truth of careless statements. At the present day, though, we find that greater caution is exercised, and that the expert sails in fairer weather, still each successful company continues the far sighted policy of maintaining the efficiency of its expert corps. The best talent is seized upon, and although perhaps, as yet, but little developed practically, is given every facility to become intimately acquainted with every detail of the technical side of the business. These young men naturally become attached to their *alma mater*, if that designation may be allowed. They become veritable missionaries in their earnest efforts to make their own particular system successful.

It is interesting to note in this connection how strongly attached many expérts become to their system. It is a curious and amusing fact that a "T - H man" or an "Edison man," who has worked his way through the factory or test room, and is finally turned out a full-fledged expert, rarely becomes completely convinced that the sun does not rise and set in his particular system. Just such loyalty as this it was which in the early days kept the public from the bad effect of a too intimate knowledge of many an unsuccessful experiment. Had it not been for the patience and indomitable energy dislayed by a certain corps of experts in charge of the equipment of a now well-known street railway in one of our Southern cities, perhaps we should not now see the present display of confidence in electric motive power.

In conclusion, then, in meting out our praises, without depreciating the value of other departments, let it not be forgotten that several of our leading electric systems owe their good name, in part at least, to those men who lost many a night's sleep in order that a burnt-out armature might be as good as new in the morning, and the manager of the embryo company none the wiser.

Henry B. Stone's Election.

The directors of the Chicago and Central Union Telephone companies held special meetings April 30, at which the resignation of Robert T. Lincoln was accepted and Henry B. Stone was elected to fill the vacancy in the board of directors. The directors then formally elected Mr. Stone president of both companies. Mr. Stone is now in Europe enjoying a brief vacation. He will enter upon his duties as president of the Chicago and Central Union Telephone companies June 1st.

Another Electric Street Railway for Milwaukee.

It is announced that another street railway operated by electricity will be built in Milwaukee, Wis. It will be about 10 miles long and will extend from the Northwestern and Union depot to the station at North Greenfield. It is also proposed to engage in electric lighting. The capital stock of the new company is $100,000 and the following named gentlemen are among the projectors of the enterprise: Paul Betchner, Hugo Lovenbach, William D. Gray, G. M. Hintley, Henry Moore, F. W. Henderson and Charles L. Dana. Articles of incorporation have been filed, and arrangements will be made to prosecute the work of construction at once.

Death of Major O. E. Michaelis and Daniel L. Gibbens.

The announcement is made of the death of Major Otto E. Michaelis at Augusta, Me. Nervous prostration, induced by his narrow escape from drowning in attempting to rescue his children last winter, was the cause of death. He was an expert in engineering and electrical matters, and was a member of the American Institute of Electrical Engineers, and recently elected vice-president. He was a member of the United States Electrical Conference and its disbursing officer by appointment from the Secretary of State, and member of the Board of Examiners International Electrical Exhibition, Franklin Institute, in 1884.

Daniel L. Gibbens formerly one of the New York subway commissioners, died of pneumonia May 2d. Mr Gibbens was born in Waltham, Mass., thirty-one years ago, was graduated from Columbia College and Law School, and in 1879 became a teacher of a school in Boston of which his father, E. A. Gibbens, was principal. He afterward became private tutor to the son of Roswell P. Flower, and upon the death of young Flower, private secretary to the father, who was then in congress. He took an active part in politics during his connection with Flower and thus attained his prominence in New York politics. Mr. Gibbens was appointed counsel to the Subway Board when Mr. Flower was a subway commissioner. When Mr. Flower resigned this place in 1886 he recommended Mr. Gibbens as his successor, and Gov. Hill appointed him. Mr. Gibbens became the leading spirit of the board, and his encounters with Mayor Hewitt furnished a number of lively chapters of municipal affairs until Mr. Hewitt declined to act any longer with the board. About three months ago Mr. Gibbens resigned his office.

Postponement of Kemmler's Execution.

Every movement in the Kemmler case is watched with interest, not only in this country but throughout the civilized world. An obscure criminal has gained world-wide notoriety owing to the fact that he is the first person condemned to death under the new electrical execution law. The case has been reviewed by the highest courts in the state of New York, and the best legal talent obtainable has been at the disposal of the condemned man. All these efforts to have the law declared unconstitutional failed, however, and at the last moment, when the prisoner had become reconciled to his fate and everything was ready for the execution, the federal court stepped in and ordered a stay of proceedings pending a review of the constitutionality of the provisions of the law, by the Supreme Court of the United States.

Roger M. Sherman, who obtained the writ of habeas corpus from Judge Wallace of the United States Circuit Court, postponing the execution, made an application in the United States Supreme Court at Washington for a writ of habeas corpus for Kemmler, under sentence of death in New York, pursuant to the order of Judge Wallace of New York, directing that he should make the application immediately. The court denied the application for a writ of habeas corpus, but informed Mr Sherman that on the 19th of May the court would hear motion for a writ of error in the case, notice to be given the attorney general of New York state This will permit the whole record to be brought to Washington and the case argued. The court follows the precedent established in the Anarchist case. As the court adjourns for the term on May 19, the decision denying or granting the writ of error will be announced almost immediately after the argument. The writ of habeas corpus issued by Judge Wallace is cancelled in the action of the Supreme Court.

A Chicago lawyer stated to a representative of the Western Electrician that there were many reasons why the United States Supreme Court would not grant a writ of habeas corpus, but if upon the application May 19 the writ of supersedeas is granted it will postpone the execution until after the case is heard in October. It is probable that the case will be given immediate attention, and a decision handed down as soon as possible, as criminal cases are given precedence over civil actions.

While Attorney Sherman of New York was engaged at Washington pressing the claims of Kemmler, Charles S. Hatch of Buffalo, who conducted the murderer's defense, secured from Judge Corbett a writ of habeas corpus, returnable at Auburn Saturday, May 10. Copies were immediately served on Warden Durston and District Attorney Quinby of Erie county. Attorney Hatch has raised the question as to whether the warden of the State prison at Auburn can legally execute Kemmler. He contends that nobody but the sheriff of Erie county could execute his client.

Another point has been raised, though it is not mentioned in the applications now under consideration. The constitutionality is questioned of the provision of the law directing the judge in pronouncing sentence to confer on the warden of the prison the privilege of naming the day and hour, within a week, for the execution. This question may be passed upon before the case is finally disposed of.

In the course of an editorial on the new aspect of the case the Chicago *Herald* says: "Electrocution in New York has unexpectedly been turned into a broad farce. A scientific and humanitarian reform has gradually degenerated into a business squabble between rival electric light companies, which are shrewdly utilizing the federal courts, the trembling criminal and the public sensibilities, for mere advertising purposes. In the meanwhile Kemmler might just as well abandon all hopes of translation and prepare to die a lingering death like the rest of us. * * * In the pause given to this proceeding by Judge Wallace's habeas corpus the question will be asked anew whether this alleged reform is not a humbug. Every one laughs at the story of the mother who was so tender-hearted that, when she was forced to chastise her refractory son, she always chloroformed him first. But the substitution of euthanasia for hanging is just as ridiculous, and for the same reason. To make execution obviously painless and almost respectable is to make it useless as a penalty. We say obviously painless, because, as a matter of fact, hanging is just as painless as electrocution, while on account of its ignominy and ghastliness it is a terror to evil-doers, which, theoretically, electrocution can never be."

The Chicago *Times*, editorially, says: "Death by electricity may be painless. Few of us are in position to speak

authoritatively on that point. But there is something as cruel as it is unusual in Kemmler's forced march up legal hills and down legal dales, sometimes in the sunshine of favorable decision, anon in the very shadow of death, and without the wit to comprehend what it is all about. Kemmler can have his revenge only by dying slyly in his bed, 'an' if he were any Christom child'—'babbling o' green fields' as innocently when his time had come as Jack Falstaff himself."

The Chicago *Tribune* says: "Whatever may be the legal aspects of the case, or its future outcome as to the cruelty of punishment by electricity, the moral effect of the law in Kemmler's case is already lost, and it may yet occur to the public that the treatment of this man has been even oppressive and that punishment of him at some future time, in case the last hope of escape is removed, would be a barbarity. Should the law be declared constitutional by the court of last resort other murderers may be promptly executed by the new method, in case it does not fail, but the constant delays and the alternate hopes and fears to which this wretched man has been subjected are not a pleasant spectacle. It is doubtful, indeed, whether there is any phase of the new method that commends itself as superior to the old, or will induce other states to copy the procedure of New York But for the change Kemmler would long ago have expiated his horrible crime at the gallows. Now he bids fair to become eventually an object of public commiseration."

In the course of an editorial on the recent legal fracas in New York the Chicago *Tribune* says: "Then let them repeal their electrocution law and return to the old-fashioned halter, and put it about the necks of murderers and send their other rascals to the penitentiary with as few delays and obstructions as possible."

The New York *World* concludes an editorial with this remark: "In trying to substitute a clever for a clumsy mode of execution this state has managed, apparently, to make murder a safe occupation for the next few years."

George Westinghouse, Jr., has sent the following card to the daily press:

The recent articles and editorials in the daily papers connecting the Westinghouse Electric company with the efforts of Roger Sherman in the Kemmler case, and with the passage of the Curtis bill for the abolition of capital punishment, have caused a number of my personal friends to insist that it is my duty to make a public denial of these statements. I therefore desire to say in the most emphatic manner possible that neither I nor the Westinghouse Electric company, nor any person associated with me, has any connection, direct or indirect, with the habeas corpus proceedings instituted by Mr. Sherman in the Kemmler case, or with the effort to abolish capital punishment in this state by legislative enactment. I make this denial without any reservation of any character. If there are any electrical interests behind these movements it is not the Westinghouse Electric company, but is much more liable to be those electrical companies which, in the hope of injuring the business of a rival, caused electric-lighting dynamos of a particular manufacture to be adopted by the state for execution purposes, and now find that the agitation which they have instituted and kept alive is reacting against themselves. GEORGE WESTINGHOUSE, JR.

New York, May 3.

The Progress of the Electric Light in Australia.[1]

BY E. J. ERSKINE.

The first introduction of the electric light into New South Wales was in 1881, when Mr H. H. Kingsbury, who two years previously had introduced the telephone into this colony, carried out an installation of arc lamps at the Redfern railway station for the government. At the present time there are upward of 5,000 incandescent and 500 arcs in the colony. In 1883 the Legislative Assembly was lighted by the same firm with incandescent lamps; Edison machines were used with great success, but lately it has been deemed necessary to increase the light, and new machines of the Manchester type have been installed. But it was really in 1887 that the advantages of the electric light were properly recognized. In this year Her Majesty's Theatre company decided to adopt this system of illumination for their new building, and a plant for 900 lamps was installed, Manchester machines being used. In 1888 Messrs. Harrison and Whiffen appeared in the field as agents for Crompton & Co., and secured the contract for lighting the town of Tamworth, where they installed a plant on the continuous current system, which has given satisfaction in the town. In 1888, also, an impetus was given to the electric lighting business through the opening of a number of skating rinks, in which the proprietors desired to have the electric light; but as these installations were nearly all of a temporary nature, the work was not of a character to be encouraged, switches, cut-outs, ampere or voltmeters being conspicuous by their absence. It would be more satisfactory to all parties concerned if the fire underwriters' rules were more stringently enforced; as, although we have so far been very fortunate in Australia, having had no accidents that could be attributed to the electric light, it is more by good luck than good management; and now that the number of installations is increasing, it is most necessary that every precaution possible to prevent accidents should be taken.

Last year was a busy year in electrical circles in all the Colonies: in Melbourne on account of the extensions of central stations, and in New South Wales on account of the number of country boroughs which called for tenders; but perhaps the most important event of the year was the introduction into New South Wales of the first alternating current transformer plant installed by Messrs. Kingsbury & Co. in Young. This plant is on the Thomson-Houston system, and the success has been such that the firm have received the contracts for Penrith and Lambton. It should, however, be mentioned that although this is the first introduction of the alternating current in New South Wales, both the Thomson-Houston and Ganz & Co have been working the system in Melbourne for some time with great success.

So far as motive power is concerned there appears to be a general leaning toward engines of the semi-portable type, and it is an exception when a plant is erected with separate boilers and engines. The standard of work done by firms in Sydney has been gradually improving during the last few years, and now it has reached a creditable pitch; the installations at the office of the *Daily Telegraph*, and that in the new hotel in Bent street—being the latest addition in Sydney—are in every respect highly satisfactory; also the temporary lighting of the Centennial Hall with arc lamps reflects great credit on the contractors. Perhaps the first thing that would strike an electrician coming here and going round the different installations would be the deplorable lack of ventilation and space in the engine and dynamo room, with one or two exceptions—a state of things highly detrimental to efficient working of the plant. Architects might be forgiven for not knowing that ventilation is a great advantage in a dynamo room from a commercial standpoint; but they should not lose sight of the fact that the attendant requires air to make it possible for him to look after his machinery. In one case the attendant is nearly suffocated by the fumes from some accumulators. It seems to be the general impression that any hole is good enough for electrical machinery.

Up to the present there is no central station lighting in Sydney; whereas in Melbourne there is a considerable amount of lighting done from the stations in operation, and there are other stations in contemplation. The reason for this difference in progress between the two largest cities in the Southern hemisphere may perhaps be accounted for by the fact that in Sydney the gas company have a monopoly of the lighting; and although two bills have at different times been introduced to enable companies to erect central stations and supply light and power, they have never got beyond the first stages, and have then been allowed to lapse. In Brisbane there has lately been a considerable movement toward the electric light; and central stations will, I think, shortly be an accomplished fact in the Northern Colony. If so, Sydney will have been left behind by all her neighbors, as at present there are no rumors of a central station here. However, the New South Wales country municipalities are, to a certain extent, making up for the indifference shown by the metropolis, as at the present time there are two of the interior towns lighted; in three others the work is in progress, and seven others are either considering or calling for tenders. Under these circumstances it must be admitted that the outlook is very promising.

So far as traction is concerned, very little has been done in any of the colonies. Some time ago a trial was made of a car on the Julien principle, but, although the trial was successful, nothing more was heard of it. At the present moment an electric tramway is talked of for Balmain, a suburb of Sydney, and I believe it is to be on the Sprague system. Victoria once more takes the lead in the matter of electrical tramways, having one at Box Hill which is giving satisfaction, although I hear the rails through which the return is made are not all that could be desired, the joints being very primitive, and therefore the resistance very great.

There is one matter that is doing a considerable amount of damage to the electrical industry. I refer to the exaggerated reports that appear from time to time in the daily papers, copied from home papers, of the dangers of electric lighting in general, and of overhead wires in particular. Many persons in the country districts reading these articles immediately imagine that the introduction of the electric light is nothing more or less than the introduction of a new kind of plague.

The subject perhaps most under consideration here at present in the country municipalities is whether arc or incandescent lighting should be adopted for street lighting. The great argument relied on by the advocates of arc lighting is, that whereas it requires 500 horse-power to obtain 100,000 candle-power with incandescent lamps, the same number of candle-power would be obtained with 50 horse-power with arc lamps. Of course this is absurd; but they will not understand that the two systems cannot be compared by their nominal candle power. So far the five municipalities who have decided on the electric light have adopted the incandescent with good results, and it certainly hardly seems necessary in towns of 6,000 inhabitants to go to an enormous expense of lighting the town with arc lamps, the night traffic being quite insignificant.

In Victoria the railway authorities are turning their attention to lighting their trains by electricity, and once more the younger colony will be ahead of New South Wales, as the system now in vogue here is an elaborate system of gas illumination, the installing of which involved a large outlay; and it is, therefore, not probable that the authorities will, for some time at any rate, consider the question of electric lighting, which would necessarily entail another large expenditure.

The prospects of electric lighting in the other colonies, viz., New Zealand and Tasmania, should be very good, the abundance of water-power which is at the disposal of engineers giving every opportunity for the electric light to compete with any other system of illumination.

[1] London *Electrician*.

Prof. Stricker of Vienna will submit to the Congress on Internal Medicine, now being held at Vienna, a new electrical lantern, which will be of great service to lecturers and medical students. By an ingenious combination of lenses Prof. Stricker contrives to project the magnified images of objects on a white screen in their natural colors, so that, for instance, a small pimple on a patient can be shown in its real appearance to an audience of many hundred students. One of the experiments will be a demonstration of the palpitations of the heart of a small animal.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 3.—Since the announcement last Tuesday that Judge Wallace of the United States Circuit Court had issued a writ of habeas corpus for Kemmler returnable June 17, at Canandaigua, the public has been most eager to get at the facts. Electricians are pretty nearly of one mind in regard to electrical execution, and are deeply gratified that its constitutionality will be again questioned. If the State legislature at Albany can so easily overlook the demand for the repeal of the unconstitutional provision of the electrical execution law, regarding the liberty of the press, it is quite proper that the federal government should rebuke the State legislature in its action in this matter. Brown's contract with the State has expired, and it is probable that it will not be renewed. The assembly at Albany has already passed a bill abolishing capital punishment, but it is hardly to be expected that the senate will concur. The vote in the Assembly was 74 for and 29 against the measure. The discussion over the electrical execution law has done much to attract the attention of the people to it. As the New York *Sun* truly said: "If Kemmler had been killed by the electric current, and by a man of scientific education, the whole civilized world would have received a shock of horror, and the sentiment would have done honor to the human race."

It is reported that there was much disappointment as well as surprise at Auburn when it was announced that Kemmler's execution would have to be postponed in compliance with the mandate of Judge Wallace. It is further stated that H. P. Brown was on hand with "assistants," and from this it is inferred that he expected to conduct the execution. It is not recorded, however, what his feelings were on learning of the intervention in Kemmler's behalf. It is not even known that he gave expression to his thoughts, but if he did his words have been lost to posterity. There is much speculation nevertheless as to his preferences. Had the execution taken place at the appointed time Brown would cease to be an object of interest even in the unenviable notoriety he has attained, but he would still retain to a certain degree a position as a public character, though it would be much the same as that of Jack Ketch.

McElvaine, of Brooklyn, under sentence of death, has been granted a new trial, and thus another subject for electrocution has, temporarily at least, escaped the fate prepared for him.

The responsibility for the dangerous condition of the streets of this city after nightfall, owing to inadequate light, rests principally with Mayor Grant, who, after crippling the electric light companies by his action and influence in the Board of Electrical Control has continued his war on the companies through the Gas Commission. This board is composed, under the law of 1873, of the mayor, commissioners of public works, and comptroller. Of course the mayor dictates the policy of the commission just as he does all other municipal boards, which are practically under his thumb, and his associates are mere figure heads. A year ago the people of this city pointed with pride to the brilliantly illuminated streets of the metropolis. Then the city had 1,328 arc lamps on its streets, but to-day there is no reason for rejoicing. The electric light service so far as the streets are concerned has been discontinued, and the city is in mourning. There are many complaints against the high handed policy pursued against the lighting companies, and it is quite probable there will soon be a reaction. It will be welcomed by all who have the good of the city at heart. Let the streets be properly lighted, as befitting the metropolis of the most progressive country in the world. Electricity is the only agent through which this can be accomplished.

One good result of the investigation of the senate committee on general laws is in calling attention once more to the faulty construction of the gas mains in this city.

Frequent changes are made in the features of the entertainments at the Lenox Lyceum, and additions are being constantly made to the exhibit of electrical apparatus and mechanical wonders. The musical performances take place at 2 o'clock in the afternoon and 8 at night, while between hours there are several twentieth century stage exhibitions, typical of modern advancement in electricity.

The case of Charles W. Pierce, superintendent of the Brush electric light station, indicted for manslaughter on account of the killing of Henry Harris with the electric current, came up for a hearing in the Court of General Sessions. After two days' proceedings Judge Cowing said that he could not see even enough proof to give the case to the jury, saying that he was sorry that the people did not have a better case. He gave it to the jury. In twenty minutes a verdict of "not guilty" was returned.

The Western Union company advanced the rates from $10 to $50 a day in the case of the pool rooms, and book

makers were obliged to suspend yesterday. This rate did not include extra services, which amounts to $20, and it is possible that this attitude on the part of the Western Union will work a reformation in this nefarious business.

In the United States Circuit Court yesterday Judge Wallace entered an order, after hearing the lawyers for both parties, allowing Thomas A. Edison to amend his bill of complaint against Ezra Gilliland and J. C. Tomlinson to recover $175,000, as part of the purchase price paid by Jesse H. Lippincott for the Edison phonograph patents to Gilliland and Tomlinson, who Edison says, were his agents, but not accounted for to him by them The court gives the defendants until June to file their answer.

The announcement of the formation of the United Electric Traction company, capital stock $7,000,000, has created considerable interest here, as it is claimed the new corporation combines the Julien and Daft interests. It is anticipated that the new combination will push ahead the storage battery traction work.

Lineman Alfred S. Wescott is lying at Chambers Street Hospital suffering from the effects of an electric shock received while he was engaged in pulling down "dead" wires in Chambers street. He was badly burned, although his injuries are not serious. He was in the employ of the United States Illuminating company.

The constantly increasing business of the American Electrical works has caused them to enlarge their facilities in this city. They have taken the whole second story at 10 Cortlandt street.

A story comes from Philadelphia purporting to divulge the plans of an immense syndicate formed for the purpose of controlling the gas companies of America and Europe. W. W. Gibbs, president of the United Gas Improvement company, is said to be at the bottom of the scheme, and it is claimed he has been assured of the support of the leading capitalists of New York and Philadelphia. English agents, representing Sir Julian Goldsrind of London and the Imperial Continental Gas company have made a proposition to join the enterprise, and this will be considered at once. It is represented that the Imperial company, which was organized at London twenty years ago, is something of a syndicate of itself, as it controls companies whose original capital stock amounted to $75,000,000, and the shares in the Imperial are listed in the London Exchange at 100 cents above par, On the other hand the United Gas Improvement company, which owns gas plants in forty cities of this country, the leading spirits of the old gas trust and the backers of the street railway syndicate organized in Philadelphia, are all earnestly in favor of the scheme. At least such is the report from Philadelphia. It is claimed that Postmaster John Wanamaker is down for $350,000 and Edward Tuck $1,000,000. W. W. Gibbs will take $5,000,000 stock in the new syndicate.

Incandescent lamps have from time to time made a rather remarkable record, but a correspondent with the Queen City Electric Light company at Gadsden, Ala., to the Sawyer-Man Electric company at New York, gives the history of a remarkable lamp. The letter says: "We have something wonderful in the way of an incandescent lamp to report to you. On July 4, 1888, we started our incandescent dynamo. Among the lamps in the station was one over the engine which has been running all night long every night since, and is still running now. Counting from July, 1888, to July, 1889, we have 365 days, and from July 4, 1889, to May 1, 1890, we have 300 days more, which together, make 665 days of 12 hours, equaling 7,980 hours. No doubt some will discredit this statement, but nevertheless it is true. The above described lamp is a Sawyer-Man 16-candle power, 110 voltage."

W. H. T.

Milwaukee, Wis.

MILWAUKEE, Wis., May 3.—It is said that either Hinsey of Milwaukee, or Hinckley of Chicago, the principal owners of the Hinsey electric street railway, will probably sell out within two weeks. An option on the line, or on the controlling interest, at any rate is in existence. Hinsey has secured an option on the Milwaukee & Whitefish Bay railway. This road, which would dovetail very nicely with Hinsey's East Side line, should the latter be built, is held at $90,000. Hinsey avers that he has no intention of selling out, and that he secured the option of the Whitefish Bay line for his own company. The most reasonable view of the matter is that Hinckley will sell out and that Hinsey will stay. The company would find it difficult to secure franchises on the East side and South side without Hinsey's aid.

A company has just been organized to build an electric railway from the lake, clear through the city, to a point near the western line of the county. It is the National Home & North Greenfield railway company and is well backed financially. The main line, which will be nearly ten miles long, is double tracked all the way. It will begin at the Northwestern depot, thence run along Michigan street and Broadway to the South side, thence to South Pierce street, thence along the Mukwonago road, past the Soldiers' Home to North Greenfield. The other line will start at the Union depot and connect with the main line on the South side. If the new company obtains a franchise on the Mukwonago road the Milwaukee City Railroad company will be prevented from extending its line to the Soldiers' Home. The new company, by the way, proposes to transport passengers from one end of its line to the other for five cents.

The Pittsburg capitalists who have purchased the Cream City railway not only intend to convert it into an electric system, but will build four new lines of considerable length. They have decided to extend both their East side and West side lines to the northern city limits, to build a new line to St. Francis Seminary, and to extend the Mitchell street line to Layton Park. The company has great faith in suburban business. The new officers are: President, O. E. Britt, Milwaukee; vice-president, Arthur Kennedy, Pittsburg; secretary, C. C. MacConnell, Milwaukee; treasurer, A. J. Lawrence, Pittsburg; general manager, A. W. Lynn, Milwaukee.

The Milwaukee City Railroad company according to Vice President Payne, is considering the different electric systems and will equip its entire line with some electric system just as soon as the new extensions are completed. Mr. Payne says his company would like to adopt the storage battery system, but the cost is too high.

Milwaukee will be a perfect network of electric railways when the systems are all changed, and the new lines completed.

The West Side Railway company, which is now running electric cars almost entirely, will duplicate its electrical plant, in order to prevent delays in case of accident.

The Milwaukee Edison Light company has commenced work upon the building in which its plant is to be located.

In two months the Board of Public Works will receive bids for furnishing public electric lights. The Badger company's contract does not expire for seven months yet, but it seems certain that it will have to overcome strong opposition before it secures another contract. An effort is already being made, in fact, to give a large special contract to the corporation which is operating under the Milwaukee Telegraph company's franchise. President Badger, of Chicago, who has been here during the week, threatened to fight anything of the kind in the courts. He believes that his contract gives him a monopoly of all electric street lighting.

C.

Pittsburg, Pa.

PITTSBURG, Pa., May 3.—Work on the construction of the line for the Allegheny Crosstown railroad has been commenced, and the company expects to have the electric cars running within three months, the construction of the road to cost $15,000.

The Second Avenue Electric Railway company, whose line runs for four miles parallel with the Baltimore & Ohio railroad, is said to have made terrible inroads on the receipts of the railroad company since the operation of the cars on April 1. Now the B. & O. people want to get even with the electric railway people, and from the 1st of May they have reduced the fares from fifteen to fifty per cent.

A large number of residents of Hiland avenue, a fashionable asphalt-covered thoroughfare of the city, are up in arms against the Duquesne Traction company because this corporation proposes to run its electric road on that street. A bill in equity has been filed against the company and the outcome of this litigation is watched with great interest in this city. The plaintiffs, and there are sixty of them, claim that the traction company has no right to lay its tracks on any street, because it obtained its franchise from a special council, which is alleged to be illegal.

The Baltimore & Ohio Railroad company has now completed its electric light plant at Glenwood station, about four miles from this city. The railroad people intend to light up all the stations between Pittsburg and McKeesport with arc and incandescent lamps. The wiring is now being rapidly pushed, and the lights are expected to be turned on by the 15th of May.

A magnificent office and light manufacturing building is about to be erected in this city, which will contain the novel feature of supplying exclusively electric power. J. M. Ferguson, a Pittsburg capitalist, is the projector of the building, which will cost $200,000 when completed. The basement of the structure is to contain a large number of dynamos which are to generate the electric power for the motors to be placed in any rooms of the building where they are desired.

Messrs. E. E Keller, C. E. Dunderdale, Austin Ready, J. Edwards, William Merrill, Geo. Keller and J. H. Ferris of Connersville, Ind., were in this city the other day. These gentlemen had been sent here as a committee from their native town to investigate the electric light system of Pittsburg. They stayed here for two days and were piloted around the Westinghouse electric works, the Allegheny County Light company's plant, and on going away expressed themselves very flatteringly in regards to Pittsburg's electric lighting.

The Perry Street Railway company, to operate electricity or cable power in Allegheny City, was chartered in Harrisburg a few days ago with a capital stock of $100,000. On the same day the Allegheny & Bellevue Street Railway company, capital $6,000, was also chartered. Both roads will be feeders to the Pleasant Valley electric railway line in Allegheny City.

The Pleasant Valley Electric Railroad company is said to be down on organized labor. Nine of the motor men were discharged a few days ago because they belonged to an assembly of the Knights of Labor. There is trouble expected, and a strike is likely to follow.

The Birmingham Traction company of this city, which is about to equip its street car line with electrical apparatus, is now making an investigation of the different electrical systems It has looked into the Thomson-Houston, Julien, Short and several others. It is said the storage battery system has found most favor in the eyes of those in authority.

The Michaels Mining Machine company has decided to erect a large factory in McKeesport for the purpose of manufacturing drills for coal mines. The plant is to cost $100,000.

The cases of the Commonwealth against the Philadelphia Electric Lighting company and the Brush Electric Light company of the same city came up before Judge Simonton the other day in Harrisburg, and the judge handed down his opinion. Both companies claim to be manufacturing concerns and as such, exempt from taxation under the recent act taking the tax off manufacturing companies. The opinion discusses at great length the means by which electricity and electric light are produced, and quotes extensively from the testimony of Prof. Henry Morton, president of the Stevens Institute of Technology, whose testimony as an electrical expert was taken in this case. Judge Simonton adheres to his opinion reached in a similar case about a year ago stating that producing electric light is not a species of manufacture. He held that neither electricity nor electric light was a material substance, that there could be no manufacture unless a material substance was produced. It is expected that the case will be argued in the Supreme court on appeal at its meeting in Harrisburg in June. In this case a great deal of evidence was taken to show the unequal operation of the present tax laws upon different corporations. The lack of uniformity it was claimed made the tax unconstitutional. Judge Simonton however, sustains the constitutionality of the tax except as to the amount involved on patent rights granted by the United States, which he holds are not subject to taxation. Upon this point the attorney general may possibly appeal. The full amount of the commonwealth's claim against the Philadelphia Electric Light company is allowed with interest and costs; but in the case of the Brush company the amount is largely reduced by the decision as to the invalidity of the tax on patent rights.

Kansas City, Mo.

KANSAS CITY, Mo., May 3.—A report to the effect that the Consolidated Electric Light & Power company of Kansas City, Kan., had increased its capital from $100,000 to $200,000 caused the WESTERN ELECTRICIAN correspondent to hunt up Ben Friedburg, the manager, and inquire into the matter. When seen, Mr. Friedburg said:

"It is true we have increased the capital stock of our company from $100,000 to $200,000, our purpose being to increase the capacity of our plant in the same ratio. We intend to erect immediately an entirely new building and to place in it the latest and most improved electrical machinery and appliances, so that we may keep up with the times and the constantly increased demand for electric light and power. We intend before snow flies again to have in all respects the best appointed plant and to be able to furnish as good electric light service as can be obtained anywhere in the world. * We are now furnishing both arc and incandescent lights cheaper than they can be obtained in any other city, one-third cheaper than they can be obtained just across the state line, but we intend this fall, as soon as our new plant is completed, to revise our rates still further, so as to make electric light a household necessity, cheaper even than kerosene oil."

The outlook for street railway building in Kansas City, Kan., this season is very bright, and it is probable that at least three new lines will be added to the already long list, making a network of roads all over the city. A large force

of men is now at work on the southern extension of the L road, which runs from the junction of the L road and Riverview cable line, down Fifth street and over the new viaduct in the Sixth ward. This road will afford great relief to the citizens on the South side who wish to transact business at the city hall and court house, as it will require only a few minutes to make the trip. The time consumed in traveling from the North to the South sides of the city at present is nearly an hour. It is understood that negotiations are being made with the Consolidated Electric Light company to furnish power to operate the road. Mr. Friedburg, president of the electric light company, said yesterday that such was a fact and that his company would also put in a bid to furnish power for the proposed Third street line, which will tap all the territory in the northern portion of the city. This line will be built this summer. The Thayer company will also build an electric road running from Argentine through the Sixth, Fifth, Fourth and Third wards of this city to the Quindaro boulevard, but it is thought that this company will build its own power house.

The Missouri & Kansas Telephone company has determined to remove from its present quarters at the northwest corner of Sixth and Delaware streets to quarters that are adapted to its present increased business. With the 2,666 instruments now in use the facilities for accommodation of new subscribers are inadequate. Whether to furnish property of its own and erect thereon a fireproof building or to lease for a long term a fireproof building to be erected for the corporation, are questions not yet settled by the company, but they will be within about sixty days. In the new building it is proposed to put the shops along with the business offices and the operating department of the company. The basement and the upper portion of the building will be occupied by the company. This would leave a portion of the building to be rented. The business will be conducted on the single exchange system, with places for about 4,000 instruments. The company has also determined to use the underground conduit system, instead of the overhead conductors now in use. The lines down town will be taken down without any coercion on the part of the city. These changes it is expected, will be made within a year.

The Kansas City Electrical society held an interesting meeting last week in the secretary's office of the Missouri & Kansas Telephone company. A complete reorganization was effected, the following officers being elected: President, Wiley W. Smith; vice-president, J. H. Aldrich; second vice-president, Thomas F. Clohesey; secretary, A. M. Birron; treasurer, Geo. W. Johnson; additional members of the executive committee, H. W. Ritterhoff, Paul W. Bossart, E. Mohahan, W. C. Moore. Meetings will be held regularly hereafter Friday evenings of each week in the telephone company's general office.

Judge H. C. Roney of the Superior court at Augusta, Ga., has recently rendered a decision on the question of street railway franchises which materially affects a number of Kansas City capitalists and railroad builders. The decision was in the case of the Augusta & Summerville Railway company against the Augusta Railway company. The latter corporation consists principally of Kansas City men, Messrs. Jarvis and Conklin being the prime movers of the enterprise. Colonel D. B. Dyer, formerly of Kansas City, is president of the company, and the electric roads for which the company has secured franchises will be built by W. B. Knight, a Kansas City engineer. The suit brought by the Augusta & Summerville Railway company against the new corporation was an application for an injunction to prevent the building of any street railroad on any of the streets of or across any of the petitioning company's tracks without a just compensation. The action is based upon the fact that in the early days of the city the common council entered into a contract with the company, giving it the exclusive right of way over all the streets of the city, except Monument street.

In denying the petition Judge Roney says that the city had no power to bind the public by ordinance or contract without the approval of the legislature, and that the act of legislature passed in pursuance thereof is void. He states further that if the petitioning company has any right to the streets it is only for a street railroad to be operated by horse or steam power; that electric motor power having been unknown at the time the franchise was granted, this company had no right to use electric power or to prevent others from using it.

Judge Roney, after citing other decisions in support of his ruling, says that to have granted the injunction proceedings against the electric company, would have been to uphold monopoly, and to balk public improvement and advancement.

Fred. H. Whipple of Detroit was in the city last week in the interest of the electrical exhibition of the St. Louis Exposition. Mr. Whipple says he is going to make an effort to bring more novelties together this fall than ever before in the history of electricity.

The electric light company of Sedalia closed a contract last week with C. S. Rusling, of this city, representing the Thomson-Houston company, for additional dynamos to the extent of the lighting capacity of 650 lights.

The report of Chief Speers for the past fiscal year was submitted to the board of police commissioners last Saturday. The chief urged that an electric police signal system be put in. Chief Speers has made such a recommendation about every year for the past five years, and so far in vain.

The electric light plant of the Exchange building is to be increased at once by an additional dynamo capacity of 360 lights. P.

St. Joseph, Mo.

ST. JOSEPH, Mo., May 3.—The People's Street Car company filed a petition with the county clerk, to be presented to the county court, asking for a right of way to Lake Contrary along the present lake road and commencing at a point at the northwest corner of Florence addition. Before the C. B. & I. property, south of Atchison street was taken into the city, the road obtained from the county a right of way through it from the old city limits at Atchison street to a point at the northwest corner of Florence addition, from where they now ask the right of way, along the lake road to the lake. The present southern terminus of the People's line is at Eleventh avenue and Atchison streets, whence to the northern end of the right of way now asked for the company claims to have the right of way, but refuses to disclose the exact route to be followed, as the full right to their use of such of this right of way as is inside the city limits is questioned, and until the matter is fully settled their object is to keep it strictly quiet. Whether the company will extend the Eleventh street line to the lake is still uncertain as it has another route to reach the lake boulevard planned out. R.

Louisville, Ky.

LOUISVILLE, Ky. May 3.—The Electric Light company at New Albany, Ind., just across the river, is making arrangements for putting in an additional machine. The new dynamo will be placed in the building now in use. It will be in operation within ninety days. The present machine has its full quota of 50 lights now in use. There is a demand for a number of additional lights, and the city is anxious to abandon about 100 of the street gas lamps in the business portion and put in 15 or 20 arc lights instead. L.

Topeka, Kan.

TOPEKA, Kan., May 3.—The Topeka Rapid Transit Railway company now has 30 motor cars, each equipped with two 10-horse power motors and 20 trail cars. The capacity of engines and boilers at the power station is 1,000-horse power. The company has now 20 miles of track.

The Edison Electric Light & Power company now furnishes current for 6,000 incandescent lights and 50 motors, with a total capacity of 625-horse power.

The Brush Electric Light & Power company now operates 90 arc lights.

The City Electric Light company operates 185 arc lights.

The North Topeka Electric Light & Power company's station has a capacity of 1,000 incandescent lights and 60 arc lights. McC.

Boston, Mass.

BOSTON, May 3.—The Boston aldermen at their meeting this week considered the report of the committee to which was referred the order relating to the increase of speed of the electric cars. The recommendations of the committee were adopted, and an order was passed fixing the rates of speed as follows: In the suburban districts 12 miles per hour; in business streets included within specified limits, 7 miles per hour; in certain specified semi-suburban districts, 10 miles per hour; and when turning street corners 4 miles per hour. The new time tables of the electric lines made necessary by these changes will go into effect to-day. The only change made by this order is the increase from 7 to 10 miles an hour in the streets of what may be called the semi-suburban districts.

At the same meeting the aldermen defeated the order granting the Suburban Light & Power company the right to erect 861 poles in the outlying districts of the city. This is the final rejection of this company's petition for this right. This defeat was by a vote of 7 to 5, and was followed by the passage of an order, 10 to 2, granting permission to the Boston Electric Light company to erect 81 poles in nearly the same territory as that covered by the Suburban company's petition.

The bill providing for the consolidation of gas and electric light companies, in Massachusetts, has passed the senate and will be considered by the house this week. It is more than likely that it will be amended in several particulars as in its present form it would make possible a combination to secure control of any and all franchises of all the companies furnishing gas and electric lights anywhere in the state.

A bill has been reported to the legislature making the inspection of electric lights and meters a part of the duties of the inspector and assistant inspector of gas and gas meters. This bill meets the approval of the state board of gas commissioners and will probably meet with a favorable reception in the senate and house. Should this bill pass it will make it the business of the inspector to measure the candle power of arc and incandescent lights whenever called upon to do so by consumers in any part of the state.

The attorney general, Mr. Waterman, yesterday sent to the house, in reply to its request, an opinion upon the subject of municipal control of lighting plants. He is of the opinion that cities and towns have no right to make and sell gas for private use, nor to make it for their own use. He says: "I can find no law or statute by which towns have been authorized to enter into business of a commercial or private nature, such as requires an investment of capital and the employment or particular application of skilled labor or scientific knowledge therein. And I am of the opinion, for the reasons stated above, that under the existing statutes, towns have no authority to construct and maintain within their own limits, and for their own use, systems of lighting by gas or electricity; nor can they, in connection with such systems, sell gas or electricity for private use in such towns." The towns which petitioned the legislature for the right to manufacture and sell electricity have all been given a polite but expressive "leave to withdraw."

Professor Elihu Thomson has just moved into his new and magnificent residence at Swampscott, Mass. His laboratory for private use, which is not yet fitted up, will be upon the second floor of the stable, and will be connected with the house by an artistic bridge. The old colonial style has been adopted for both house and stable, the material used being brick. The house is surrounded by as fine a grove of trees as one could wish to see.

The new Thomson-Houston electric locomotive intended for use upon the West End street railway arrived in the city last week. It was drawn from Lynn to Boston by six horses. It will soon be put to service drawing one or perhaps two cars. It is fitted with an air brake worked by a small stationary motor placed in one corner of the "cab."

Another Robinson radial car has arrived at the central power house of the West End company. It has six wheels, a 15-foot wheel base, and is capable of seating 40 passengers, 20 on each side. The truck is made entirely of steel. This is a closed car, but an open one of similar design with 12 seats seating 60 persons, will soon be equipped and both will be put into service. It is expected that before the very hot weather begins 17 of these cars will be running on our streets.

The Fitchburg Railroad running out of Boston has reduced the fare to some of its nearest suburban towns in order to compete with the electric lines of the West End street railway. O. H. M.

Indianapolis, Ind.

INDIANAPOLIS, May 3.—The street car company is pushing work on the Illinois street electric line. The power house is completed and the boiler is now being put in place. The engines and dynamos have been shipped and will soon be in position. The motor cars are nearly ready. Work on the track, portions of which are being relaid with new rails, is being pushed day and night. The poles are ornamental iron and are set in the middle of the street between the tracks, and all are in readiness for stringing wire. The company expects to begin running cars by the middle of May.

James Clark, an employe of the Indianapolis Brush Electric Lighting company was killed at their station last night while attempting to make a connection at the switchboard. The line he was attempting to make connection with carried current for 67 arc lights. This is the first accident that has happened at that station in the ten years it has been operated.

The Telephone company is making some changes in its lines along Illinois street to prevent interference from the new electric car line on that street. They report a large number of applications for new connections; at present they have something over 1,200 instruments in service. M.

THE ELECTRIC LIGHT.

The Westinghouse company is now manufacturing a 25 light alternating current arc machine.

The incorporation of the Chicago Illuminating company was reported last week. The corporation will furnish

electric lights. It has a capital stock of $500,000, and the incorporators are: F. S. Wheatop, D. S. Gooding and E. M. Miles.

Work on a 10-story building on Clark street, Chicago, was begun last week. The structure will be of iron and pressed brick, with a frontage of 75 feet and 107 feet deep. The cost will be $250,000. The entire building will be lighted by electricity, and a number of motors will also be installed for operating elevators, etc.

The Omaha Fuel Gas company has purchased the Council Bluffs gas and electric light plants. The property is valued at $300,000. The company has decided on the enlargement of both the electric and gas plants in Council Bluffs. An outlay of $25,000 for new buildings and $50,000 for the extension of mains will be made.

The Westingbouse alternating current arc light apparatus was sold during the month of April to electric light companies for central station plants at Troy, N. Y., 60 lights; Saratoga, N. Y., 60 lights; Salt Lake City, Utah, 25 lights; Evanston, Ill., 120 lights; Joliet, Ill., 60 lights; Martins Ferry, O., 40 lights; Uxbridge, Mass., 60 lights; Oxford, O., 60 lights.

The Thomson-Houston Electric company reports the following sales for the past week: Geo. Merritt & Son Woolen Mill company, 100 incandescent lights for their woolen mill at Indianapolis, Ind.; C. C. Travis, Tecumseh, Mich., 50 1,200 candle power arc and 650 16 candle power alternating current incandescents; Aurora Electric Light & Power company, Aurora, Ill., 35 2,000 candle power arc lights; Camden Electric Light & Power company, Camden, Ark., 650 alteroating incandescents.

During the month of April the Westinghouse Electric company sold its alteroate current incandescent apparatus for central stations' electric lighting plants in the following places: Portsmouth, Va., 1,500 lights; Saratoga, N. Y. (increase), 1,500; Salt Lake City, Utah, 500; Mt. Morris, N. Y., 300; Brookline, Mass., 900 (increase); Johnstown, N.Y., 500 (increase); Springfield, Mass., 3 000 (increase); St. Thomas, Ontario, 750; Ouray, Colo., 750; Sherman, Texas, 750; Detroit, Mich., 6,000; Susquehanna, Pa, 750; Elmira, N. Y., 750 (increase).

The Electric Light company of Muskegon, Micb., is one of the marks of interest to the people of the town and they point with no little pride to the efficiency of their service. At present the company has 209 arc lamps in operation, and 550 incandescent lights. It also supplies power for motor service, and this branch of the business is coming into prominence The power house is a large two story brick structure, substantially built, containing six engines aggregating about 800 horse power. Six 45 arc light dynamos and a 1,000 light alternating machine occupy the second floor of the building. Petroleum is used for fuel and the company claims that it not only has the advantage of cleanliness, but it has also proved economical

The use of electricity enabled a photograph to be taken recently under most exceptional and difficult conditions. A landslide occurred at a quarry in France, and a large number of workmen were buried in the subterranean gallery. It was supposed that the men were entombed in one of the galleries about 220 feet below the mouth of the mine; but nothing certain was known of their position, and for an attempt at rescue to have any chance of success an approximate idea of their whereabouts had to be gained. The difficulty was surmounted by sinking a shaft about a foot in diameter, in the direction of the gallery, and through it lowering, by means of a chain, a small camera, mounted in a metallic tube. The camera was pivoted within the tube at its upper end, so that it might be fixed at any angle by tightening or slackening the connecting cord. Above and below the camera were placed rows of incandescent lamps, and when the apparatus had been lowered the camera was made to incline outward from the case. In order to photograph the interior of the gallery all that was necessary was to turn on the current and light the incandescent lamps, the plate being exposed at the same time. In this manner excellent results were obtained from a photographic point of view, the time of exposure being five minutes.

English electrical engineers are considering the question of adopting a standard of light. An exchange says: "Though the light of glow lamps is spoken of as so many candles, candles are never used in the determination. In London the Methven screen, or more recently the pentane standard, is employed. Electric lighting, being a new and interesting industry, has attracted the attention of a great many unpractical and purely scientific men; and they have brought out the square centimeter of solidifying platinum as a light unit. Gas companies and practical gas analysts have no leaning toward square centimeters or solidifying platinum, and such a proposal cannot but cause confusion. The British association committee has defined the candle in terms of the platinum standard; but unfortunately the matter, from a commercial and legal point of view, is none of the British association's business. Whether the vague standard candle remains, or the definite pentane lamp comes into use, the practical standard will not be made to fit the platinum unit; but if the new standard does not come out the exact fraction of the platinum standard, it is the British association unit that will have to alter, not the new standard. What is wanted is, not a definition of unit light that has the appearance of having something to do with the C.G.S. system, but a legally and accurately defined standard whose exact value can always be reproduced."

Attention has heretofore been called to the introduction of an electric light plant by the Cincinnati, O., Gas & Coke company. The capacity of the system is 500 arc and 2,000 incandescent lamps. The Wood and Slattery systems are employed. The company has made arrangements to double the capacity of the plant. A representative of the company said recently: "We have been in active operation only about a month, with the most encouraging results, having in that short time introduced 140 arc lights and nearly 800 incandescents. We have just closed a contract with Joseph T. Carew for lighting his mammoth establishment with 100 arc and over 1,000 incandescent lamps." The gentleman quoted, General Hickenlooper, known to every gas man in the country, says the electric lamp in Cincinnati to-day gives "a light superior in steadiness and brilliancy to any lights heretofore seen" in that city.

The Peoria Electric Light & Power company of Peoria, Ill., formerly the Jenney Electric Light & Power company, has just completed and started its new station. The engines were built by E. P. Allis & Co., of Milwaukee, one 250-horse power and one 450 horse power double expansion compound condensing. The shafting, pulleys, clutches, etc. were furnished and erected by the Hill Clutch Works. The dynamos running 450 2,000 candle power arc lights, are of the latest improved Thomson-Houstoo make. The plant also includes 2,000 Thomson-Houston alternating incandescent lights. Also two 80-horse power Westinghouse 500 volt generators for furnishing power; one 60-horse power generator Royal Electric company's make. The switch-board is made entirely of marble and cost $1,750 before it was set up. Mr. Hadley, of the Thomson-Houston company, superintended the erection of the electrical apparatus in the central station. The station equipment was furnished by the Thomson-Houston company except that for the Westinghouse generators. This company is also remodeling its entire system of wiring. All the connections are to be resoldered, and everything is to be overhauled. Thos. Coffey has lately been appointed manager. The company has thirteen towers and is lighting the city by contract.

THE ELECTRIC MOTOR.

Oakland, Cal., will have an electric railway on Grove street.

The construction of the Pittsburg electric street railway at Pittsburg, Kan., was begun last week. The Pittsburg Electric Lighting company will furnish the power.

It is said that the first alternating current motor in Italy has just been started. The machine is of 5 horse power, and is running at Alzano Maggiore. It is used to drive a centrifugal pump.

A press dispatch from Milwaukee says: "The directors of the Milwaukee City Railway, at a meeting next week, will consider a proposition of the Edison company to transform their street railway into an electric system, using the storage battery instead of the overbead wires."

The track laying for the electric railway at Sedalia, Mo., has begun. The company has eight car loads of rails on the ground near the power house on Broadway, and ties in abundance All the poles are in position along the route indicated, and the work will progress as fast as skilled labor and a large force of men can make it.

Chas. W. Robison, of Peoria, Ill., was in Chicago this week for the purpose of purchasing electrical apparatus for a new electric power station in Peoria. This power station he is intending to erect under the franchise formerly granted to the Royal Electric company which franchise he reserves to himself in the sale of the Royal Electric company's factory.

The Rochester, N. Y., Electric Railway company will have its cars running on Lake avenue, one of the most prominent residence streets in the Flower city, July 10th. The company has asked permission to establish lines across the new river bridges now in course of construction, but the city surveyor opposes the proposition owing to the fact that the specifications for the bridges were drawn without reference to the electric lines, in fact before the electric railways were in sight.

The consolidation of the electric light and power department of the Birmingham (Ala.) Gas, Electric Light & Power company with the Birmingham Union Railway company was effected recently, together with the placing of the Ensley and Bessemer dummy lines under the consolidated management, the total mileage of these roads aggregating 39 miles; 15 miles horse and 24 miles single track dummy line. It is now proposed to operate the entire system by electricity, and the Thomson-Houston Electric company, it is reported, has proposed to equip the entire system with the overbead system for $1,000,000 cash. First mortgage bonds of the consolidated roads will be issued. The Birmingham Union Railway company has been granted a franchise for an electric road by the city.

In a published interview, a prominent Western capitalist is reported as saying after investigating the operation of electric street railways: "Boston afforded the best opportunity of any city I stopped at to see how electric railways worked. There are probably more miles of electric street car lines in Boston than in any other city, and so far as I was able to learn, the system gives universal satisfaction. The wires overbead, through which the current comes, do not make any trouble, and nobody complains of them. And, when electric cars can be run satisfactorily in Boston, I am sure they can be run satisfactorily anywhere. There are no blockades by break-downs, and cars go as fast as the ordinances of the city will permit. The sentiment in Boston is so generally in favor of the electric car service, that new lines are being projected."

The electric railway is converting inquiring capitalists in every direction. According to the Buffalo *Commercial* Mills W. Barse a capitalist of the City of Breezes who until quite recently advocated the introduction of cable roads has pronounced in favor of the electric system. He said in explanation of his change of opinion: "Because I have thoroughly investigated the trolley system personally in Boston, Atlantic City and other places, and I am entirely satisfied that there is no system like it for the public use and for the public benefit. I always like to own up when I am wrong. I have fought the trolley system all along, but the other day after I became converted I wired Mr. Box that I had to acknowledge that the trolley system was by all means the best available for rapid transit. If the two companies push the system right ahead you will see a boom that will surprise even the most sanguine believers in Buffalo's future."

The franchise for a street railway granted G. W. Thompson over a year ago, from the present terminus of the Tacoma, Wash., Railway & Motor company's Eleventh street track, out Eleventh street to the city limits, is about to be turned to practical account, according to a local paper. Mr. Thompson will build the line or transfer the privilege to the Tacoma Railway & Motor company. If he does the former, arrangements will be made, in all probability, with the Tacoma Railway & Motor company, to operate it as a part of the present system. The section of the city over the brow of the hill out Eleventh and intermediate streets is being rapidly and steadily built up. Street car facilities are badly needed, and they will doubtless soon be furnished them. Work on the Thompson line, it is said, will soon begin. It has also been reported that the Tacoma Railway & Motor company would operate the Manning, Bogle & Hays line from Tisdale's addition east to a cross line along N or O streets to be built by themselves. This could not be confirmed, but it would easily place a large section of the city tributary to a system now in operation. Definite action in regard to all these various lines will be taken in a few days.

THE TELEGRAPH.

The committee recently appointed by Board of Trade men at Chicago to consider the question of establishing a new telegraph line between Chicago and New York, have reported favorably on the project. This is one of the results of the recent Board of Trade controversies.

The lot of the telegraph operator in England is not a happy one, and the "cracks" of that country have organized a Postal Telegraph Clerks' association. The chief grievances complained of are insufficiency of pay, overwork, and stagnation of promotion. Another grievance is the deduction of pay during sickness, which seems hard when the unhealthy conditions under which much of the telegraph work of England is done is taken into consideration. Owing to the lack of encouragement, so dissatisfied are many telegraph operators with their present position and prospects, that of late large numbers have left the service and gone out to the colonies.

The recent telegraph tournament in New York has called attention to the fact that many distinguished men have been knights of the key, and many others have enjoyed great prominence, though their notoriety did not gain them wealth. The New York *Sun* tells the following story about the adventures of Milton J. Adams, who was once distinguished as a "crack": "He is the man who, during the strike in 1870, mounted a box in a San Francisco street and sold patent medicine at large profit for the boys, who were just then very hard up. From San Francisco he went to South America, where he traveled with a lion show; crossed the Andes selling maps to the natives, who could not understand them, and made a fortune in the restaurant business in Rio Janeiro in six months. He lost the fortune on the Coffee Exchange in two days He ran a newspaper in the Kimberly diamond fields in South Africa for a time. One evening a party of prominent citizens, who had been 'celebrating' pretty freely, displayed their patriotism by singing, and insisted that Britannia was the boss of the whole mundane show. Mr. Adams' paper came out next day with an article in which he stated that, although Britannia might be under the impression that she ruled the wave she could not rule the Yankees, who had whipped her twice, and were ready to do it again on short notice. He also suggested that if the participators in the festivities of the previous night were as zealous in imbibing information as champagne they would be better citizens and more desirable neighbors. An animated mass meeting was promptly held, and the editor left before it was over."

THE TELEPHONE.

The department of posts and telegraphs of France has decided to erect in Paris a large central telephone exchange with a capacity of 30,000 subscribers.

It is reported that "a new telephone has been brought out in England, which is said not to infringe upon any existing patent. It is of the most simple construction, consisting of an electro-magnet and celuiloid diaphragm, the patent of George Lee Anders, which is working under concessions by the telephone company which has brought it into the market. There is nothing which is likely to get out of order, and for domestic use it certainly appears to answer its purpose well." The attention of representatives of the telephone interests in this country have been called to this matter, but they have no knowledge of the alleged invention.

Miscellaneous Notes.

Dr. Purcell Taylor of London, writes the WESTERN ELECTRICIAN that he has discovered a new insulating compound, "which," he says, "is only one-fortieth part of the cost of gutta percha, while it offers a far greater dielectric resistance. The new material is very strong. It may be made either flexible or rigid, and any desired color or melting point may be given to it."

Herr Lueders of Goerlitz, has recently invented a thermometer for ascertaining the temperature depths of the sea. Its action depends on the different electric conductivities of substances at different temperatures. Inside a glass tube are fixed a spiral iron wire and a bar of carbon, which only touch at their lower ends. Their other ends are connected to copper wires, which constitute an electric

circuit, and in this circuit there is a galvanometer which indicates the differences in the current due to the variations in the temperature of the contents of the glass tube.

The Western Gas association will hold its thirteenth annual meeting at the Lindell Hotel, St. Louis, May 21–23. Among the papers announced for this meeting is one on "What Policy Should the Gas Interest Adopt in Connection with the Approaching World's Fair?" by Walton Clark. It is to be hoped that the Gas association will show better judgment than the newspapers of St. Louis.

Another application of electric current to the race track has reached a high state of perfection. The electric pool register will be generally introduced this season. This instrument will register the number of tickets sold in the mutual race pools. It consists of nine dials. On eight small dials are placed the names of the horses in the race and the number of tickets sold on any particular horse by any number of ticket sellers, and these separate items are all recorded on a large central dial. By means of this device a ticket seller in the grand stand can communicate any transaction to the dials in the betting booth at any moment.

It is pleasant for an American to read such a paragraph as this, taken from the London *Electrical Engineer:* "Handsome posts carrying iron pipes to act as conduits for electric wires are now being proposed for American cities. Nothing in the nature of architectural or wrought-iron ornamentation would, however, get over the obtrusive features of large piping ramifying in all directions above the footwalks. The method is brought forward in all seriousness, and has been patented, and it is stated there is much likelihood for it to be introduced in some of the towns in the United States." It would seem from the above that our transatlantic cousins are quite ready to believe that the American electrical engineer is willing to tolerate any sort of monstrosity in the line of electrical construction. The writer of the lines quoted might, we think, spend a few weeks in the States most profitably.

A Washington news letter furnishes the following interesting notes: "An employe in the office of the architect of the Capitol, Washington, has invented an electric musical machine. The keyboard is similar to that of an ordinary typewriter, and its keys are connected electrically with a number of electric bells arranged beneath the table. Pressure on each key closes the circuit of an electric bell, and when the keys are operated by an expert any tune may be played on the machine. * * * Electricity is applied to a device for the compilation and tabulation of census and other returns of a similar nature which require summation and classification under various heads and in different groups. The method consists, essentially, in first recording the data relating to each person by printing holes in sheets or strips of paper and then counting or tallying these data either separately or in combination by means of mechanical counters operated by electro-magnets, the circuits through which are controlled by the perforated strips. This system is a thoroughly practical one, and it is estimated that its use will save nearly $580,000 in compiling the returns of the next census."

The New York *Sun*, ever alert in the interest of those who are unable to take care of themselves hails with delight the introduction of the electric station indicator for city railway lines. It believes that it will prove a boon to the "belated and weary" Gothamite who, it says, "can now rouse himself from his ex tempore nap on the homeward journey, and by a glance upward, dispel all fears of having passed his station, and the traveler on an unfamiliar line can possess his soul in patience in the blissful consciousness that the hopeless vocal distortion which the railway conductor seems to regard as his rightful prerogative, has lost its terrors." These indicators have for some time been in use on the cable lines of Chicago, and they are now giving great satisfaction. At first, however, they played many pranks until the grip men became accustomed to them, and only a short time ago a band of small boys on Wabash avenue, undertook to relieve the grip men of their duty of ringing up stations, and made life miserable for the patrons and employees of that line, and it is feared it will require the united efforts of a large number of temperance orators to counteract the effect of their work.

Personal Mention.

W. S Turner of Woodbridge & Turner, New York city, was in Chicago last week.

Messrs. Forbes and Jackson of the Michigan Telephone company, Detroit, and Frank Rae of the Detroit Electrical works, visited Chicago last week on business.

Myron A. Knapp of the Knapp Electrical works, Chicago and W. G. Halm of the Perkins Lamp company, were among the passengers on the Chicago, Rock Island & Pacific train, which was wrecked at Chicago Tuesday, April 30th. Both escaped serious injury, though they were badly shaken up, and Mr. Knapp sustained several abrasions.

Business Mention.

The offices of the Chicago Arc Light & Power company have been removed from 76 Market street to 53 Dearborn street.

Frank A. Wunder, western agent of the Schuyler Electric company, has moved from his old quarters on La Salle street to room 456 Rookery building.

The Knapp Electrical Works, of Chicago, are preparing to meet the demands for fan motors which has grown to such great proportions during the last season. The special features of this outfit have already been described and illustrated in the WESTERN ELECTRICIAN. They have proved so efficient that dealers who handled them last year are already filing their orders for this season's supply, and it is a noticeable fact that already orders have been received for nearly as many motors as were turned out last season. This indicates not only an active season for the motor business but an increase in business for station companies.

The Electrical Supply company, Chicago, is handling the Ajax dry battery and is meeting much encouragement. Those who have given it practical tests pronounce it an excellent battery, and many dealers have given substantial proof of its popularity by repeating their orders.

The Crocker-Wheeler Electric Motor company, of New York, writes: "To meet the extraordinary demand for our motors we have removed to the building bounded by Washington, Thirteenth and Fourteenth streets, New York. We have been compelled heretofore to ask indulgence in filling orders. With our vastly increased facilities we are now able to handle all business promptly."

An immense roll of vulcanized rubber belting weighing 4,800 lbs., exhibited in the windows of the New York Belting & Packing company, No. 15 Park Row, New York city, attracts considerable attention from passers-by. It is the large vulcanized rubber main driving belt, made by the company for the New York Central & Hudson River Railroad company, to be used in their new elevator "A." A card attached gives its weight as 4,800 lbs.; it is 350 feet long, 52 inches wide and 8-ply thick.

The Northwestern Electric Supply & Construction company of Seattle, Washington, has recently been reincorporated under the name of the Northwest Electric Supply & Construction company, with a paid-up capital of $75,000. This is the pioneer company in the far Northwest, and has installed a majority of the electric plants in that section. The Northwest company holds valuable agencies, carries complete stocks of supplies in both Seattle and Portland, and has a large trade in Washington, Oregon, Idaho and adjacent territory.

The Ball Engine company reports the following shipments of engines: The Algonquin company, Dundee, N. J., one 25-horse power; Denver Electric Illuminating company, Denver, Colo., two 80-horse power; Pueblo Light, Heat & Power company, Pueblo, Colo., two 100 horse power; U. S. Gunboat Concord, two 15-horse power; U. S. Gunboat Bennington, two 15-horse power; House of Correction, Chicago, Ill., one 35-horse power; Philadelphia & Reading Coal & Iron company, Pottstown, Pa., one 35-horse power; Chicago House of Correction, one 80 horse power; Guarantee Loan Building, Minneapolis, Minn., two 100-horse power; Pennsylvania Depot, Chicago, Ill., one 80-horse power; Albany Journal company, Albany, N. Y., one 35-horse power; Louisville Hotel, Louisville, Ky., one 80-horse power; Ferd-Heim Brewing company, Kansas City, Mo., one 25-horse power; Willamette Bridge Street Railway company, Portland, Ore., one 150 horse power; Pennsylvania Normal School, Lockhaven, Pa., one 35-horse power; Tuscarawas Electric Light company, Canal Dover, O. one 100-horse power; Manitou Springs Electric Light company, Manitou Springs, Colo., one 100 and one 80-horse power; Cleveland Arcade company, Cleveland, O., one 125 and two 100-horse power; Greenwich Gas & Electric Light company, Greenwich, Conn., one 100-horse power; Pensacola Electric Light & Power company, Pensacola, Fla., one 100-horse power; The Devereaux Lumber company, Charleston, W. Va., one 150-horse power; Tom L. Johnson, Cleveland, O , one 100-horse power.

Electrical Patents.

Issued April 29, 1890.

426,436. Trolley Equalizer. George F. Corliss, Mansfield, Ohio.

426,437. Electric Heater. Charles W. Drew and Edward R. Francis, Minneapolis, Minn.

426,452. Crossing for Overhead Wire. John Kuehnle, Detroit, Mich.

426,462. Tablet for Telephones and Clamp Attachment for the Same. John B. Morris, Cincinnati, Ohio.

426,471. Brush and Holder for Electrical Machines. Edwin W. Rice, Jr., Lynn, Mass.

The invention consists in brush-holding mechanism whereby there is secured at all times a good electrical connection between the line and brush, while at the same time the brush is free to play up and down should it be necessary for it to do so on account of irregularities or roughness of the commutator.

426,479. Apparatus for Manufacturing Electric Light Carbons. Henry A. Tremaine, Cleveland, Ohio.

426,499. Device for Measuring Electrical Currents. Thomas H. Hicks, Detroit, Mich.

426,522. Electrical Train Signal. George D. Burton, New Ipswich, N. H.

426,554. Message Recording Instrument. John C. Wilson, Boston, Mass.

426,555. Message Recording Instrument. John C. Wilson, Boston, Mass.

426,563. Induction Coil. Anthony M. Frankenberg, Baltimore, Md.

426,570. Regulator for Dynamos and Motors. William T. Peel, St. Paul, Minn.

The invention consists of the combination, with a series of immovable contact points representing the terminals of the sections on the field magnets or a series of resistances, of a contact brush mounted in a peculiar manner and adapted to be moved over the surfaces of the contacts.

426,573. Potential Controlling Device. William Stanley, Jr., Great Barrington, Mass.

426,574. Regulation of Electric Motors. William Stanley, Jr., Great Barrington, Mass.

The method consists in developing a flow of current by means of the drop in potential upon the line between each motor and the generator, and causing such currents to traverse regulating coils upon the motors in a direction determined in the case of each motor by the distance of such motor from the generator.

426,576. Dynamo Electric Machine. Jonas Wenstrom, Orebro, Sweden.

426,580. Electric Railway. Edward M. Bentley, New York, N Y.

The invention consists of the combination, in an electric railway, of an insulated supply conductor supplied with a series of movable exposed contacts normally housed in a position inaccessible to the contact device, but brought successively into engagement with the same as the vehicle travels over the railway.

426,583. Switch Apparatus. Minor M. Davis, Brooklyn, N. Y.

426,591. Quadruplex Telegraphy. Francis W. Jones, New York, N. Y.

426,621. Electrical Signaling Apparatus. James U. Mackenzie, New York, N. Y.

426,650. Electric Engine. Robert W. Thompson, Cleveland, Ohio.

426,657. Electric Motor Car. John A. Brill, Philadelphia, Pa.

426,658. Electric Motor Car. John A. Brill, Philadelphia, Pa.

426,660. Electric Lamp Post. William Carroll, Chicago, Ill.

426,688. Electric Fire Alarm. Charles H. Shaffer, Rockford, Ill.

426,691. Fire Alarm Telegraph System. John Speicher, Jersey City, and Frederick T. Fearey, Newark, N. J.

426,699. Regulator for Dynamos. James J. Wood, Brooklyn, N. Y.

426,705. Circuit Closing Hinge for Electric Burglar Alarms. William M. Bleakley, Verplanck, N. Y.

426,706. Burglar Alarm. John H. Bleoo, Brooklyn, N. Y.

426,708. Electric Railway Car. John A. Brill, Philadelphia, Pa.

426,724. Method of Making Electrodes for Secondary Batteries George E. Heyl, Charlottenburg, Prussia, Germany.

426,749. Automatic Telegraph. Frank Anderson, Peekskill, N. Y.

426 778. Safety Hook for Electric Lights. John Dalton Danvers, Mass.

426,781. Electric Refrigerating Apparatus for Railway Cars. Mark W. Dewey, Syracuse, N. Y.

The sixth and last claims read:

6. "The combination of a vehicle, a suitable source of electricity, and an electric cooling apparatus on the vehicle in circuit with the source.

20. "In a system for cooling cars by electricity, the combination of a plurality of cars coupled together, an electric supply conductor on one of said cars, an electric conductor having one or more parts adapted to be cooled by a current and connected to the supply conductor, a reservoir containing a medium and arranged to be cooled by the said parts, and pipes extending from the car containing the reservoir to one or more of the other cars coupled thereto."

426,788. Apparatus for Producing Sheets of Metal by Electro Deposition. Moses G. Farmer, Eliot, Me.

426,789. Electrolytic Apparatus for Forming Copper Ingots. Moses G. Farmer, Eliot, Me.

426,819. Duplex and Quadruplex Telegraph. Francis W. Jones, New York, N. Y.

426,832. Automatic Fire Extinguisher. Joseph Madden, Providence, R. I.

The object of the invention is to protect every room in a building with a fire extinguishing device that will be so sensitive to heat that on a rise of temperature to a point which indicates that a fire has been started will instantly open a valve and admit water or other fire extinguishing fluid to the part of the room where the fire is and extinguish the same automatically before the fire can spread, or increase in volume.

426,917. Thermostatic Circuit Closer. William H. Chambers, Fulton, Ky.

426,932. Galvanic Battery. Fernand Gendron, Bordeaux, Gironde, France.

426,941. Telegraph Key. Oscar Kleber, Allegheny, Pa.

426 971. Electrical Fuse. Hugo Tirmann, Cleveland Ohio.

426,989. Apparatus for Electrical Communication. James L. Cutler, Piketon, Ohio.

426,992. Electrical Measuring Instrument. Madison M. Garver, Newark, N. J.

Claim fourteen reads as follows:

"In an electrical measuring instrument containing a vibrating pivoted index needle, a scale plate independently movable in the direction of a radius drawn from the zero or initial point thereon to the pivoted center of said needle, and means for holding said plate in adjusted position."

427,014. Electrical Tell-Tale Device. Edward F. Roberts, Rochester, N. Y.

The invention consists in an apparatus by which one or more tell-tale devices, located at different points, may be operated by the index finger of an ordinary gas meter or other registering device.

427,022. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

427,024. Circuit Closer. Henry B. Whitaker, River Point, R. I.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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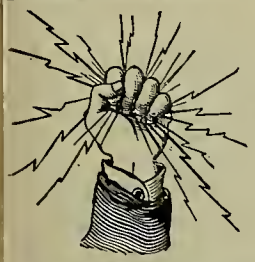

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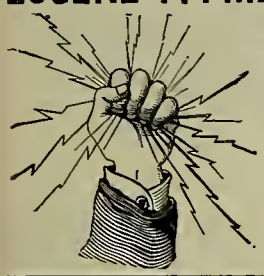

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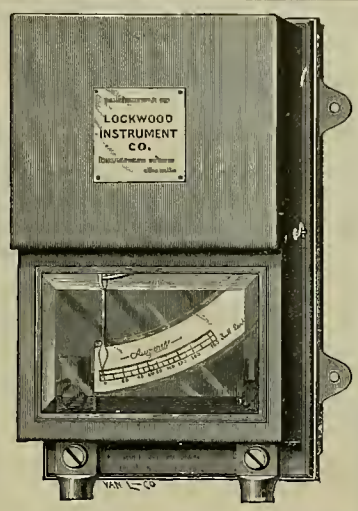

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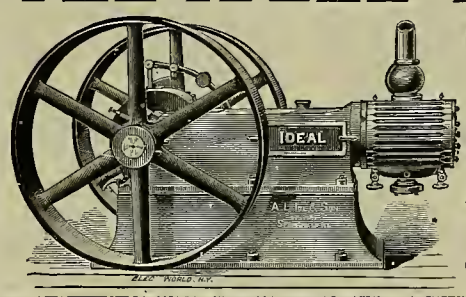

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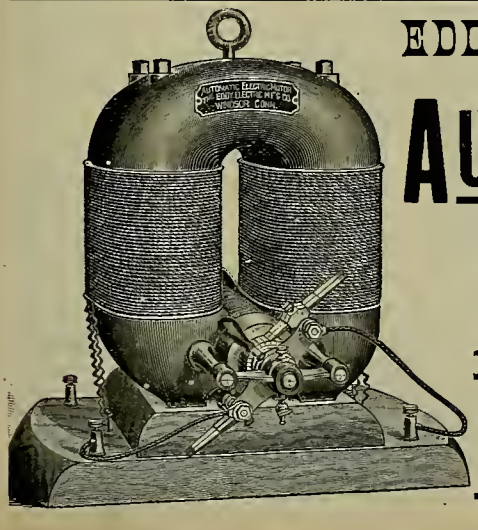

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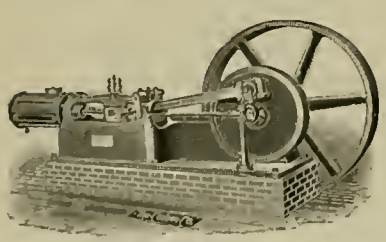

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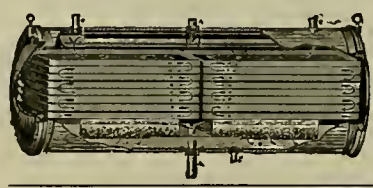

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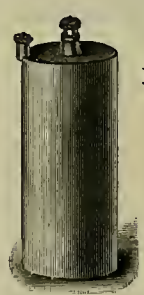

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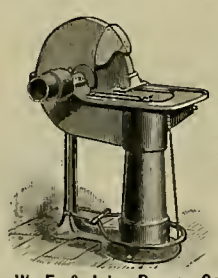

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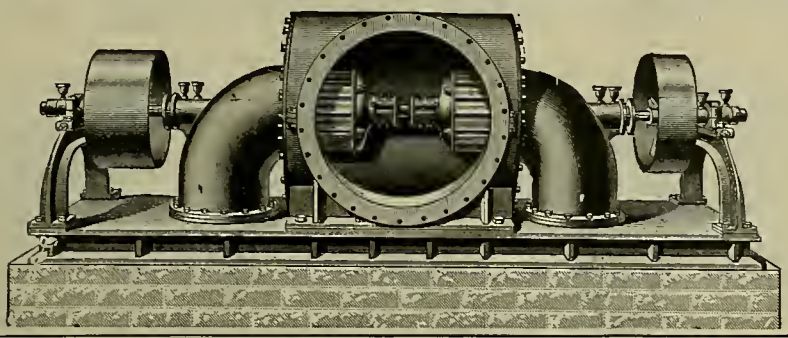

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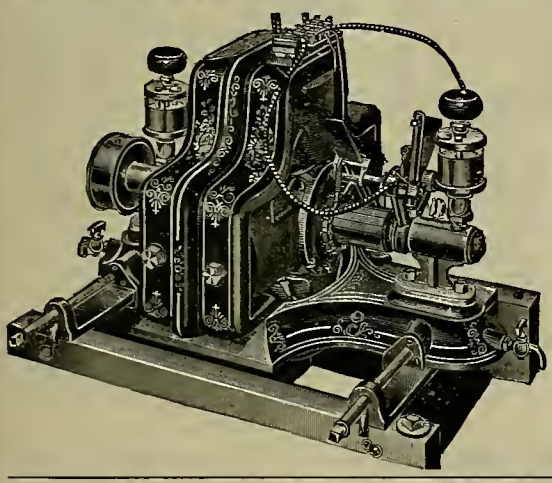

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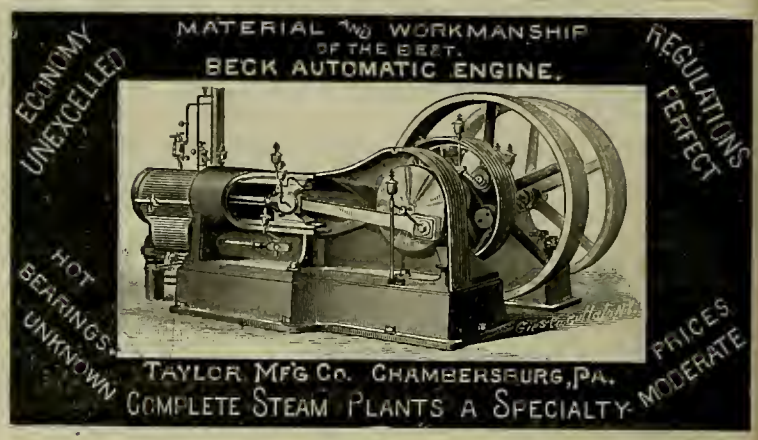

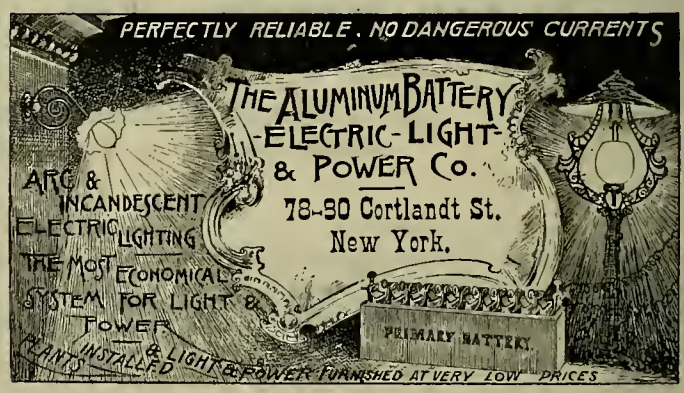

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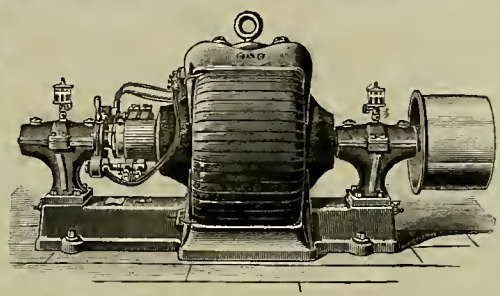

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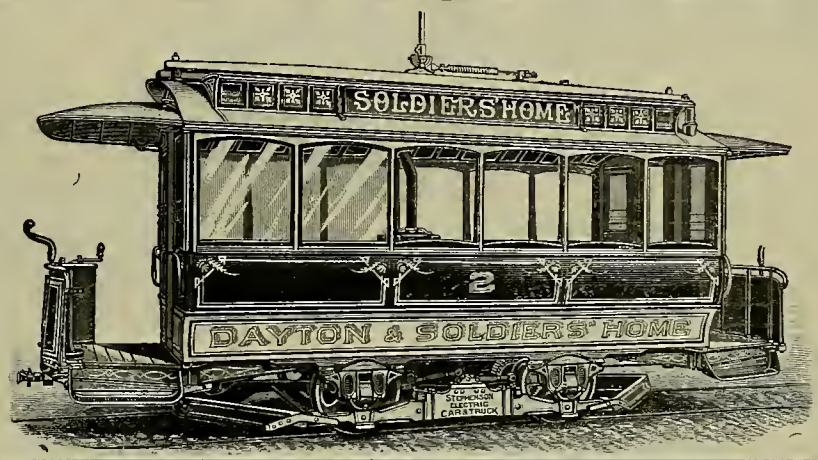

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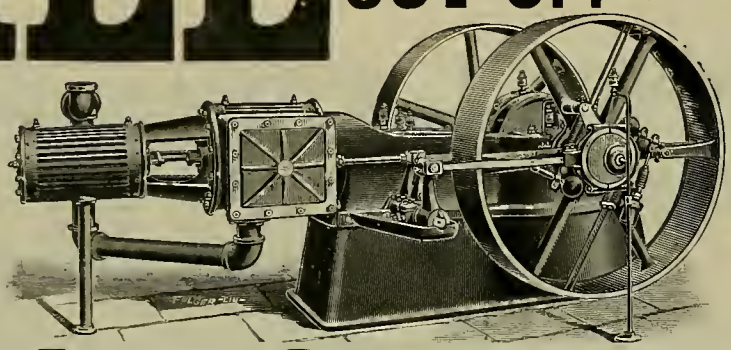

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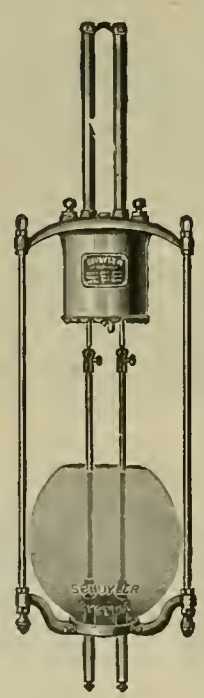

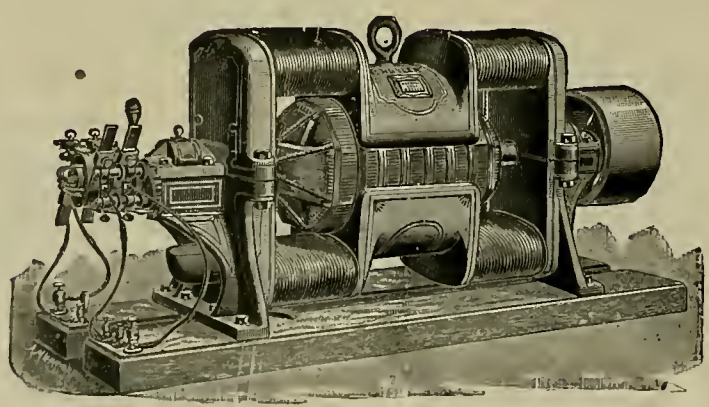

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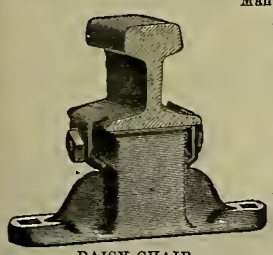

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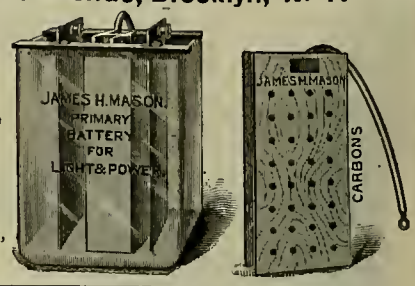

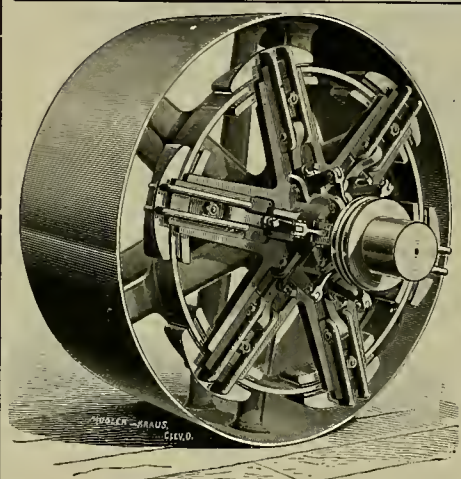

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The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:--

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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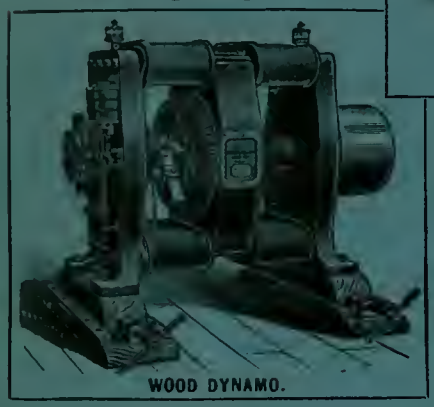

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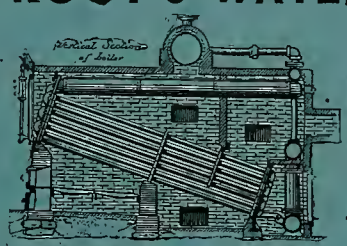

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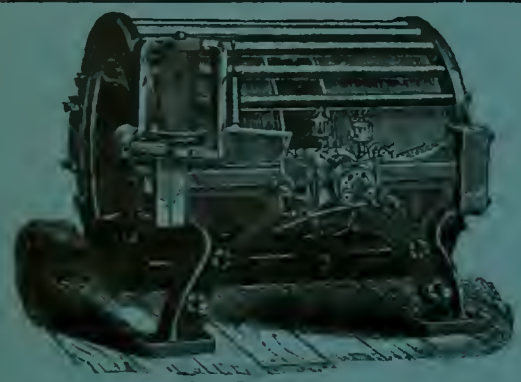

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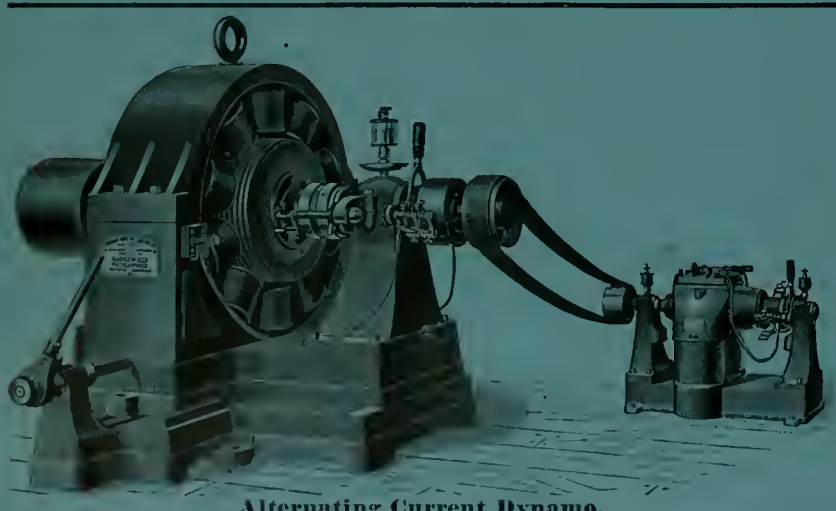

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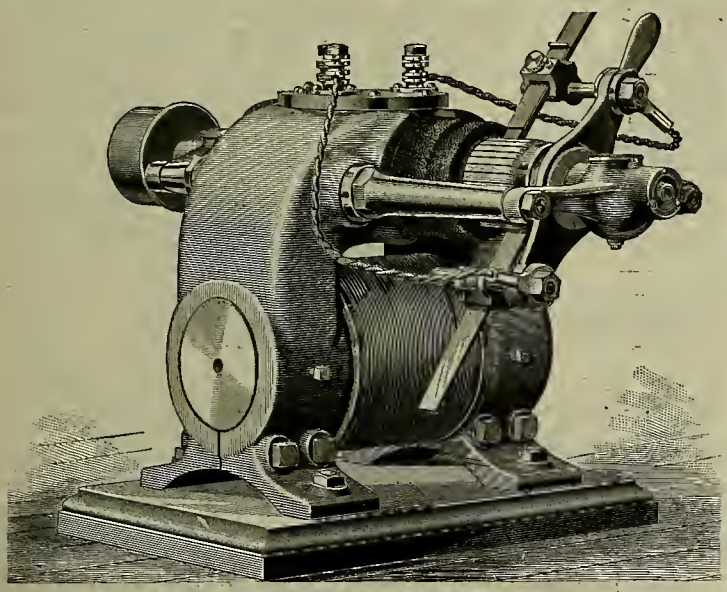

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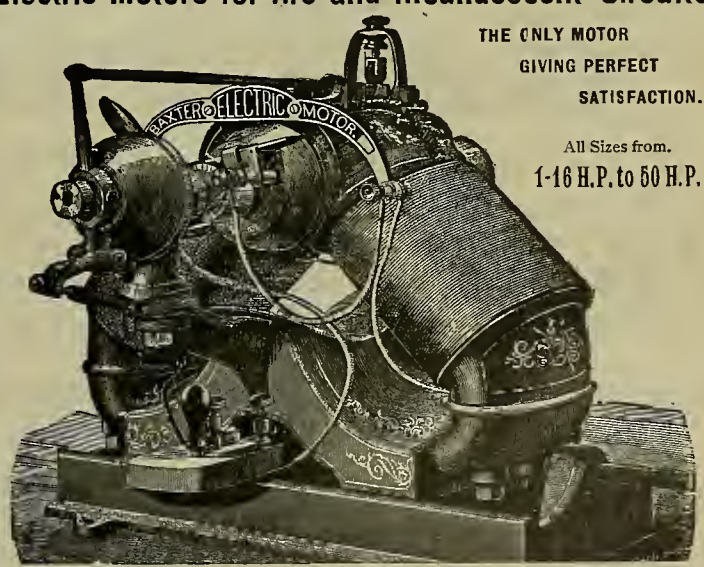

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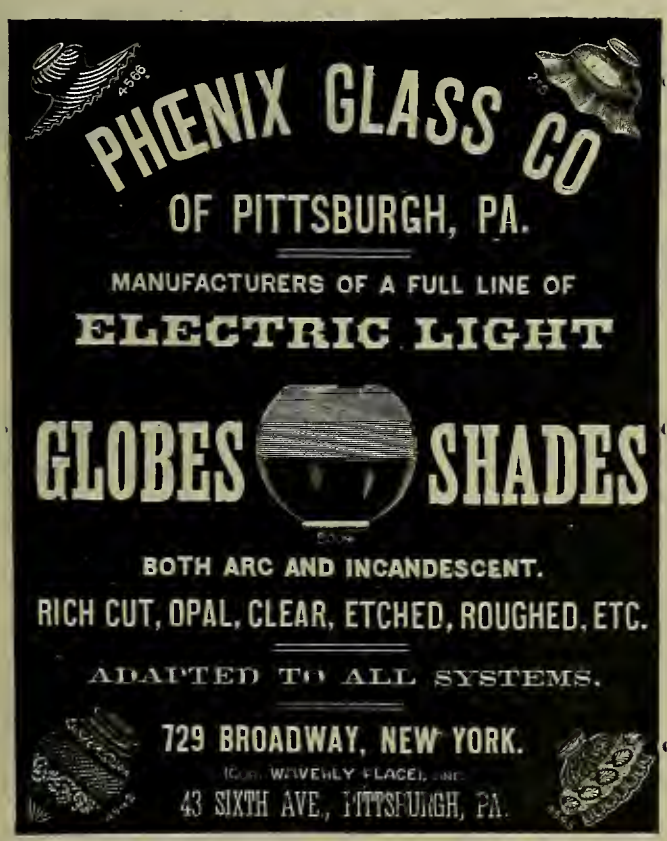

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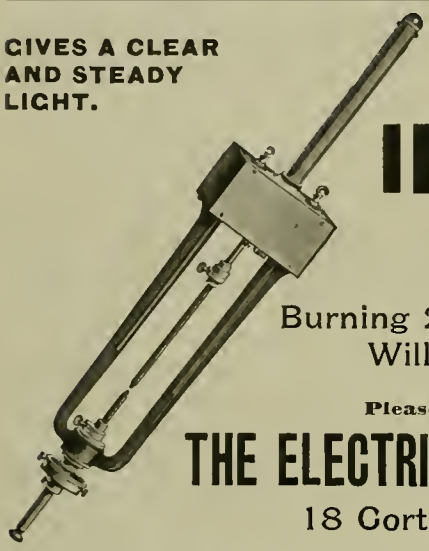

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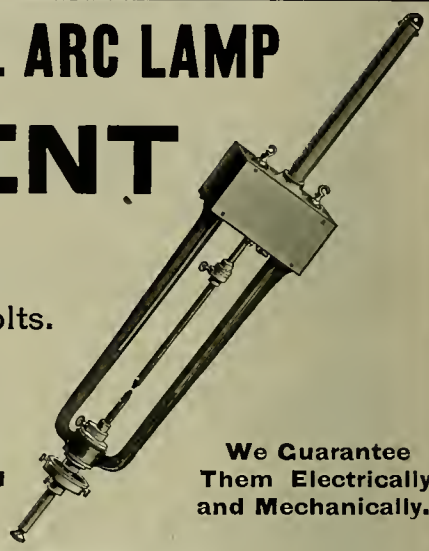

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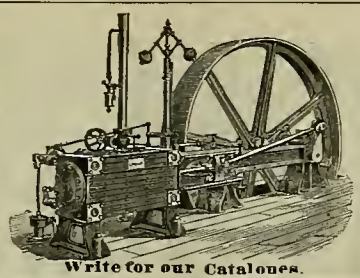

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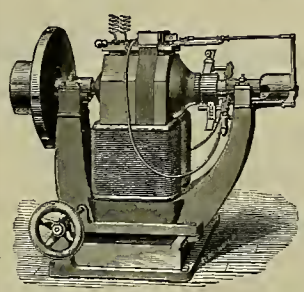

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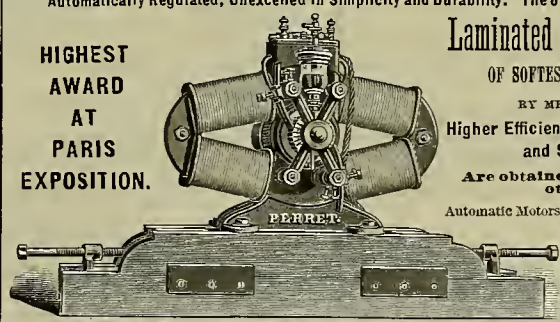

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ALL CANDLE POWERS,
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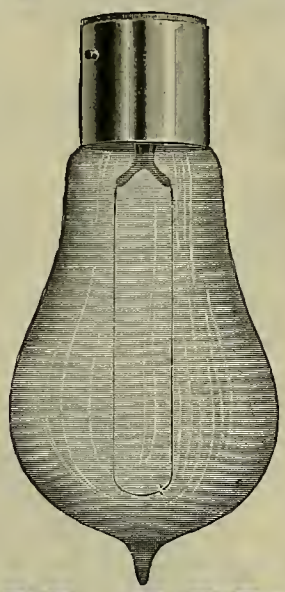

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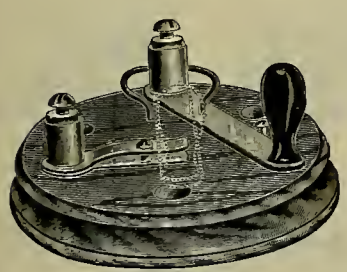
McLennan Switch.

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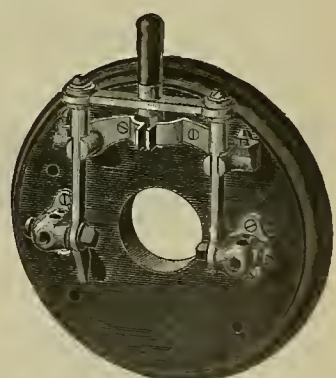
Arc Lamp Wall Switch.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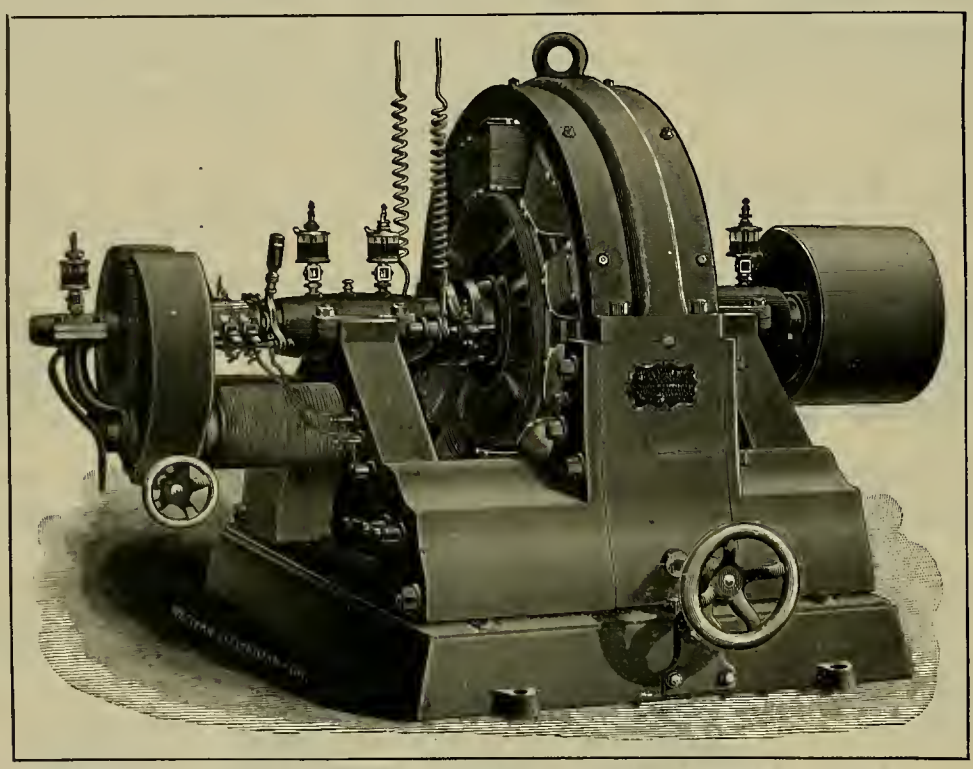

SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

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We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

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THE BRADY MAST ARM. — For suspending Arc Lamps over street intersections. The best thing of its kind in the world. Over 7,000 of them now in use.

OKONITE WIRE. — The very best Insulated Wire made. Guaranteed proof against moisture and chemical action.

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THE BUTLER HARD RUBBER CO. — We keep constantly on hand a full line of Tube, Rod, and Sheet Rubber, also a full supply of Soft Rubber Tubing.

THE BURNLEY DRY BATTERY. — The neatest and most reliable of all Dry Batteries.

THE LOWELL WRENCH. — A new labor-saving tool for putting in Lag Screws and Bolts.

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WHAT USERS SAY!

"I have five lamps out of a group of eight, which have burned 10 hours per day for the last nine months and 13 days, which makes a burn of 2,830 hours, with lamps looking almost as good as new."—East Liverpool, O., Western Electric Co.

"The Sawyer-Man lamps underwent the severest test during the last two months They are the best and finest in the market. No other lamps could stand the heavy strain and vibration at the Fair building."—An Exhibitor at the American Institute Fair, 1889.

"We have lamps still burning that have been in use ever since we put in the plant."—Cowperthwait & Co., Brooklyn, N. Y.

"Our Sawyer-Man lamps have given remarkably good service, averaging over 1,500 hours, and with a good light."—C. H. Nichols & Co., Laurel Hill, L. I.

"We have lately been using your lamps, which give us better satisfaction than the ———— lamps in use heretofore."—West Point, Neb., Electric Light and Power Co.

"They give a splendid, white, well-distributed light."—Vancouver, B. C., Electric Illuminating Co.

"The average life of the lamps on our plant up to last June was 2,800 hours. Since September we have lost very few lamps, so that the average life is very much greater than this."—Dr. W. A. Drysdale, Philadelphia, Pa.

"We are highly pleased with the lamps and think they will have much better life than the ———— make."—Hutchinson, Kan., Water Light and Te'ephone Co.

"Some of the first lot of Sawyer-Man lamps, put in over two years ago, are still in use."—Saxton & Thompson, Trov, N. Y.

"The lamps furnished us under your contract have given excellent satisfaction. We have quite a number of lamps now in use and burning brightly, which have been in constant use, on an average of six hours per day, since January 2, 1888."—Portland Block, St. Paul, Minn., September, 1889.

"We consider them superior to the lamp furnished us by others."—Electric and Water Supply Co., Neillsville, Wis.

"One of the lamps has been burning since August 1, 1888, making 16 hours each day, and is still a good lamp. We think that as you make such a good lamp, you are entitled to have their merits acknowledged by those who are daily using them."—F. E. Coward & Co., Philadelphia, Pa.

Sawyer-Man Electric Company,

New York, Boston, Chicago, Pittsburg, Pa., Cincinnati,
Portland, Ore., San Francisco, Dallas, Tex.,
Charlotte, N. C., St. Louis, Mo.

THE

WESTINGHOUSE ELECTRIC COMPANY.

Pioneers in Electric Lighting by Alternating Currents.

Incandescent Dynamos of 500, 750, 1,500, 3,000 and 5,000 16-c. p. lamps capacity.

Two Hundred and Eighty-five central stations using our incandescent apparatus.

No electric lighting system for central station purposes can be successful without the aid of an accurate meter. Our Shallenberger meter is incomparable.

Arc Lighting.

We desire to call particular attention to our new alternating current arc lighting system.

By its use the double carbon lamp becomes a thing of the past.

Our single carbon lamp runs forty hours without renewal.

The operation of the lamp is attended by a minimum of expense.

The horizontal rays of the alternating current produce the most effective light

Please write for particulars. We are always happy to point out the advantages enjoyed by those who employ our apparatus.

OUR MAIN OFFICES AND WORKS ARE AT

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We have Branch Offices at

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The Filling Hole in Top Cap is covered with Snap Lever, which cannot be displaced by jarring or shaking of machinery.

Fig. 1. Shows oil dropping while machinery runs.

POWELL'S PATENT "SIGNAL"

Dynamo Oilers,

THE BEST IN THE MARKET.

Sight Chamber is fitted with square window panes, which are secured by brass end plates, and can be removed for inspection, cleaning or repairs at any time, without stopping the oil feed, while the machine is running.

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NOS. 50, 52 AND 54 PLUM STREET,

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Please send for Prices and Discounts.

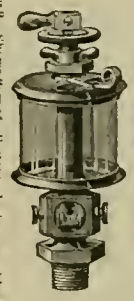

Fig. 2. Shows flow of oil stopped when machinery stops.

Flow of oil can be instantly stopped or started without changing degree of feed.

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ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

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Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

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SECOND TO NONE.

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A practical dynamo builder. Must understand constructing Gramme armatures. None but a competent man wanted. Single man preferred. Address, stating wages, "MANUFACTURERS," care WESTERN ELECTRICIAN, Chicago, Ill.

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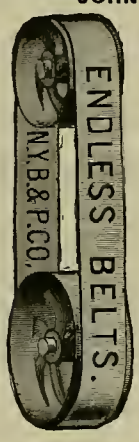

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SAFETY—Absolute immunity from electric fires.
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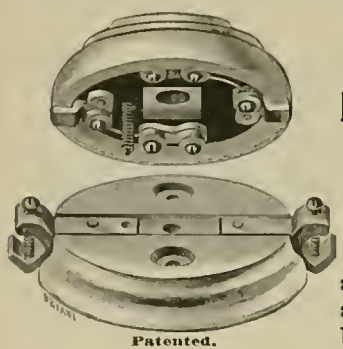

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Western Electrician.

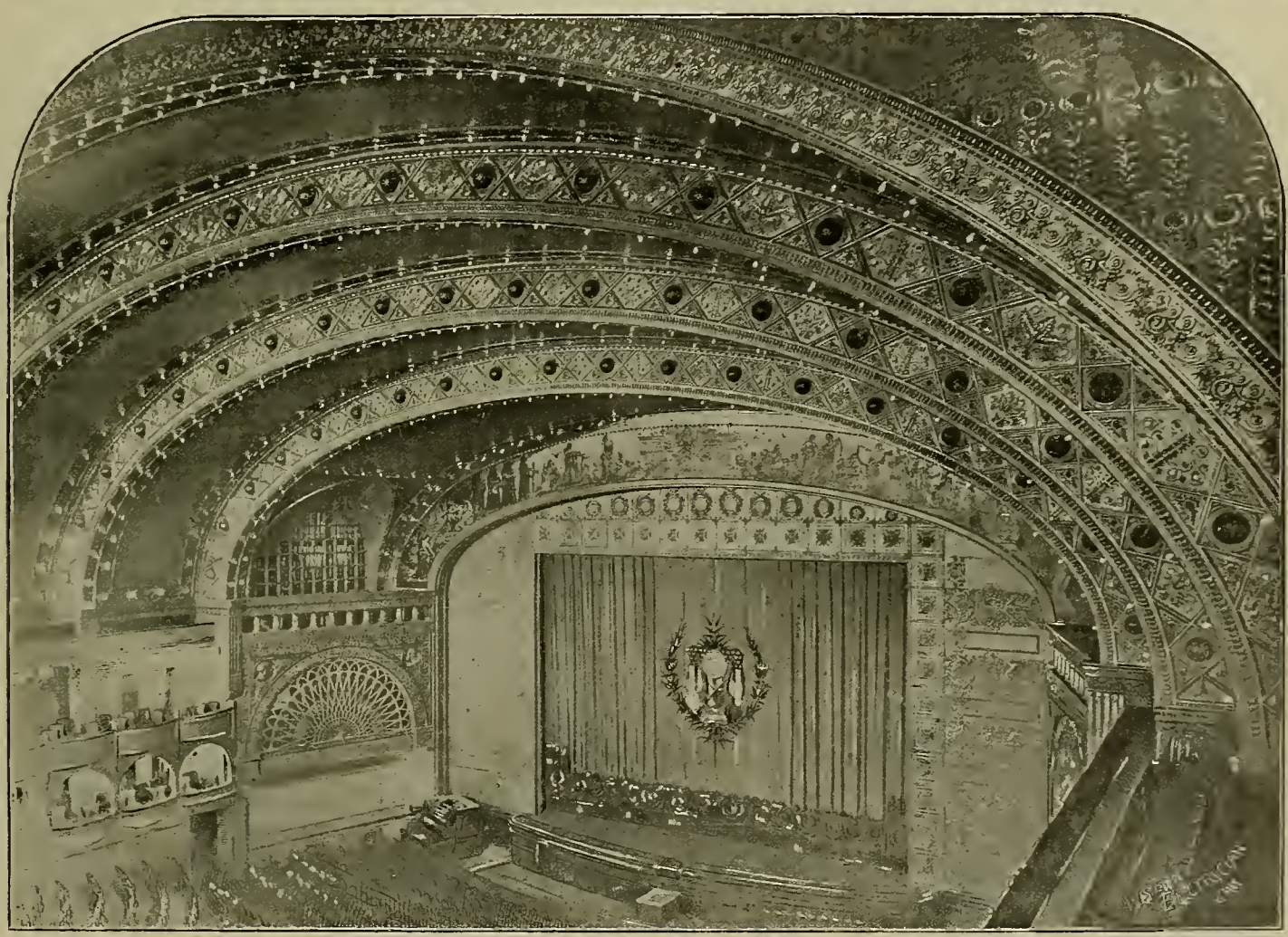
EVERY SATURDAY.

Vol. VI. CHICAGO, MAY 17, 1890. No. 20

The Lighting of the Auditorium Theater.

The Auditorium has been opened to the public for several months, and few Chicagoans have failed to examine the many features of interest in this magnificent building. A great deal, too, has been written and published concerning this immense theater; still those who have not seen the effect can form at best but a poor idea of the actual appearance of the interior when brilliantly illuminated in the evening by electricity. A number of pen and ink sketches of the interior have been published from time to time in several of the daily newspapers, and a few poor photographs may be seen, but these, while clear enough to enable one to form a general idea of the effects worked out by the architects, yet fail necessarily to represent much of the detail of the decorations. The engraving presented herewith is an accurate representation of the distribution of lights throughout the hall. The photograph, taken by Taylor of Chicago, from which the engraving was made, was secured from the first balcony, with the camera directed toward the stage. The effect of the lights in the arches, of course, is most clearly represented, but one loses a great deal by the absence of that soft, golden tint which is the prevailing coloring of the walls and decorations. This color effect is most striking when the entire house is suddenly illuminated. The quick change from darkness to light, together with the harmonious blending of colors, is striking in the extreme. The hall appears as though filled in an instant with sunlight.

For the photograph from which the accompanying illustration was made, the WESTERN ELECTRICIAN is indebted to E. S. Hand, Chicago, who is preparing for the Auditorium syndicate an illustrated book descriptive of the building.



THE LIGHTING OF THE AUDITORIUM THEATER.

Municipal Control of Electric Plants.

City Electrician Barrett of Chicago is one of the most earnest advocates of municipal control of light and power plants in the country. He has given the subject much attention, and is satisfied that it is the only solution of the problem. Prof. Barrett becomes enthusiastic occasionally during his discussion on this favorite topic, and his predictions of the accomplishments of electricity would startle Bellamy.

"The gas company forced me to consider this question," said the professor the other day, when discussing the matter. "The quality of light furnished in this city by gas is simply horrible. Why, I can't read by it. At 6 o'clock every night the gas companies put their force pumps on and raise the pressure, pumping air into the pipes instead of gas. This is the article the city of Chicago gets for street lights—the same for illuminating residences. No wonder there is opposition to gas companies. The city cannot protect itself. It is the same in all other large cities. Gas companies are formed and franchises granted them on promises of improved service and reduced prices. They no sooner get their pipes down than the old companies gobble them up, and there seems to be no redress. I have watched this thing going on for years, and I am convinced the only way to do is to build immense electric stations to furnish light and power, and use gas only for domestic purposes. It isn't fit to use for light any way, and it won't be used in Chicago ten years from now, excepting for heating and domestic purposes."

Prof. Barrett does not think there is any ground for the belief that the city could not conduct a plant as cheaply and efficiently as a private corporation. "On the contrary," he said, "there are to my mind good reasons for

believing that we could knock the corporations out.

"In the first place we could get a better class of employes. Of course there might be riff-raff for helpers, but they can be found everywhere. There isn't a big corporation in Chicago that hasn't a lot of 'help' that is utterly useless. Positions requiring skill and knowledge of electrical machinery would be filled only by the best men in the market, and we could command this class of employes because we pay better wages and the city employes have an easier time in the matter of hours. You object that this would increase the cost of running the plant; the pay roll would be materially increased, but the additional expense would be a trifle in the aggregate cost of operation. Practical men will admit that it pays to keep good men in such work and pay more for skilled labor. You will save the difference, and more, too, in other items. You wont have so many break-downs, your repair accounts will be diminished, and many other items of expense will be materially reduced. Don't you know that an intelligent mechanic always takes pride in any production of his skill or ingenuity? Well, it's the same way in an electric light station. The position requires a man of brains and training, and such a man always takes pride in his work. There would be little danger of incompetent service, I can tell you, and it would not cost any more in the end, either.

"The electric companies of Chicago are making money. The best evidence is the fact that they continue in business. The stockholders are not in for fun, and if they didn't get returns they would soon pull up stakes and get out. They pay large salaries, not only to employes, but to officers; they pay good dividends on the stock, and they support costly associations and send representatives to conventions and exhibitions. These, of course, are 'educators,' but they cost lots of money."

Although Prof. Barrett is earnestly in favor of inaugurating the policy outlined in Mayor Cregier's message, he fears it will be some years before the plan can be executed. So far as entering into competition with the local companies is concerned, he says there is not the slightest reason to believe that such a course would be pursued. If the city determined to go into the electric lighting business it would have to buy up the plants of the local companies, for the public would not tolerate such an injustice as the extermination of an enterprise that has done so much for the city.

The Book Table.

PRACTICAL NOTES FOR ELECTRICAL STUDENTS. By A. E. Kennelly and H. D. Wilkinson. London Electrician Publishing and Printing Company.

The book is a reprint of a series of articles which appeared in the London *Electrician* under the caption of "Letters for Learners and Unprofessional Readers." The letters were begun by Mr. Kennelly, who was compelled on account of change of business location to leave his task uncompleted. The work was finished in a creditable manner by H. D. Wilkinson. It has been the object of the authors to present their thoughts in plain, simple language, omitting mathematics, as far as possible. For this reason the book will find many appreciative readers. Chapter 1 treats of the earlier ideas of electricity, electric energy, chemical energy, electromotive force, difference of potential, direction of current, etc. The second chapter is devoted to batteries, and the third to electromotive force and potential. Chapter 4 relates to resistance, chapter 5 to current, chapter 6, current indicators, chapter 7 to simple tests, with indicators; chapter 8 to calibration of current indicators, and chapter 9, which constitutes fully one-half of the book, to magnetic fields and their measurement. The book is well written, and will commend itself to many readers.

Wire Peeler.

Those who have handled annunciator and office cotton-covered wire will appreciate the value of a device, by means of which insulation can be removed quickly, and with less trouble than when a penknife is employed. Figs. 1 and 2 illustrate a little tool which works most satisfactorily as a wire peeler. Besides being useful for removing the insulation, it works most effectively as a wire cutter. In order to cut the wire, the tool is applied, as shown in Fig. 2, and given a quick jerk up and down. By this action the wire is notched, and can be readily broken off.

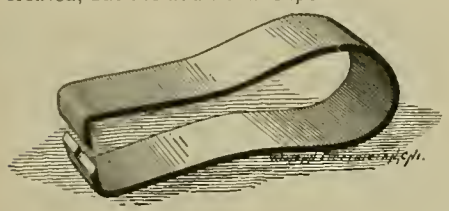


FIG. 1. WIRE PEELER.

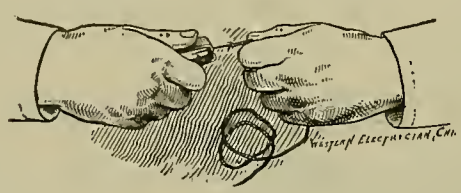


FIG. 2.

A man can remove the insulation from the ends of wire with this tool, it is stated, in one-tenth of the time required with a knife or pair of pliers, and the work is more neatly done. The tool is the invention of F. L. Perry of Chicago, and is handled by the Central Electric company of Chicago.

Warner Regulator for Constant Current Dynamos.

The cuts presented herewith represent an ingenious regulator for constant current dynamos,

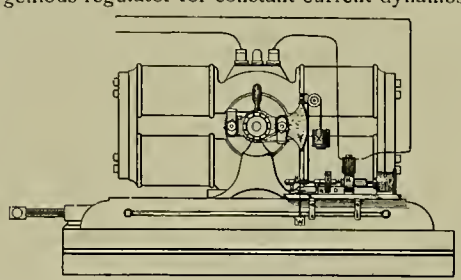


FIG. 1. WARNER REGULATOR FOR CONSTANT CURRENT DYNAMOS.

which has recently been designed by E. P. Warner, Chicago.

The object of the invention is to change the brushes upon the commutator of the dynamo responsively to variations in the current strength, so as to maintain the current practically uniform under varying load.

The manner in which this is accomplished may be understood by the aid of the diagrams. Fig. 1 shows the regulating mechanism in position on a dynamo, while Fig. 2 represents the apparatus somewhat in detail.

Referring to Fig. 2, *M* is a small C. & C. constant current motor connected in the main line. The shaft, *S*, of this motor is provided with bearings which permit of a slight longitudinal movement or thrust. Upon this shaft is mounted a screw, *P*, which is inclosed in a chamber containing a liquid. The liquid may be glycerine or some similar substance. The chamber is constructed as shown to prevent the liquid from rotating too freely with the screw.

On the other end of the shaft is a friction disk, *D*. This rotates in close proximity to a circular plate, *N*, on a short shaft, *H*. This shaft, *H*, connects, as indicated in Fig. 1, with the brush yoke of the dynamo. The action of the regulator may now be readily understood.

It is evident that the rotation of the screw in the liquid will give the shaft, *S*, a thrust toward the circular plate on the end of shaft, *H*. The amount of frictional engagement will be determined by the thrust of the shaft, *S*, and this thrust depends upon the current through the motor, which determines the speed of the revolution of the screw in the liquid. Thus, as shown in Fig. 1, when the current is increased and consequently the frictional thrust, the weight *W* will be wound up and at the same time the brush yoke Y, connected with the shaft *H*, will be moved to carry the brushes forward. If, however, the current falls below the normal, the weight, *X*, will act upon the brush-carrier and the shaft *H*, and they will be carried in a direction to move the brushes back far enough, so as to increase the electromotive force and bring the current up to its normal strength.

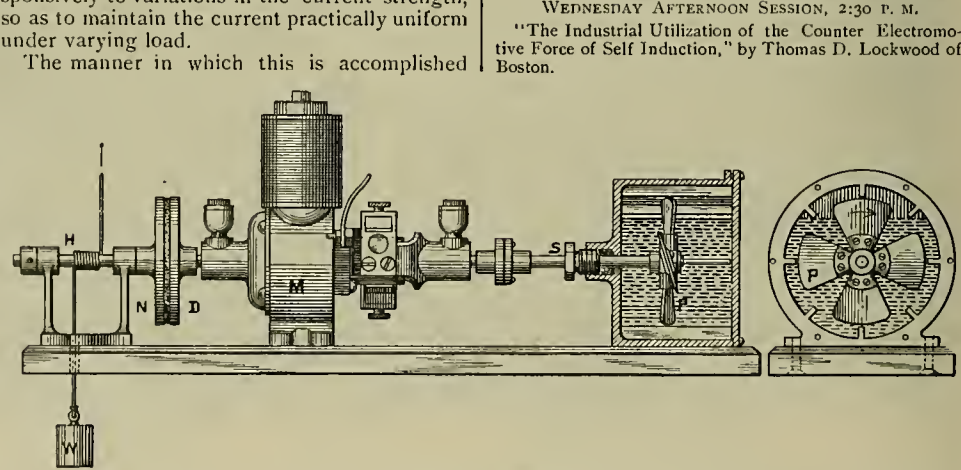


FIG. 2. WARNER REGULATOR FOR CONSTANT CURRENT DYNAMOS.

Annual and General Meetings of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers will be held in New York at the house of the American Society of Civil Engineers, 127 East Twenty-third street, May 20th. Officers for the ensuing year will be elected, after which a paper on "Electricity in the Navy" will be read by Gilbert Wilkes, late of the United States navy. After the meeting the members will assemble at the Grand Central depot, and take the midnight train for Boston, where the general meeting of the society will be held on the following day. The sessions will be held in the "new building," corner of Boylston and Clarendon streets.

The proceedings will be opened at 10 o'clock Wednesday morning, with an address of welcome by Gen. Francis A. Walker, Ph. D., L.L.D., president of the Massachusetts Institute of Technology.

After a response by President Elihu Thomson, the following papers will be read:

"Electric Lighting in the Tropics," by Wilfrid H. Fleming of New York City.

"Magnetic Data of the Sprague Street Car Motor," by H. F. Parshall of New York City.

"Note on a New Photometer," by Dr. Edward L. Nichols of Ithaca, N. Y.

"The Limitations of Steam and Electric Transportation," by Oscar T. Crosby of New York City.

At 1 P. M. a recess of one and a half hours will be taken.

WEDNESDAY AFTERNOON SESSION, 2:30 P. M.

"The Industrial Utilization of the Counter Electromotive Force of Self Induction," by Thomas D. Lockwood of Boston.

"A Study of Arc Light Carbons," by Louis B. Marks of Cornell University.

"The Practical Aspects of Alternating Current Theory," by Dr. Michael I. Pupin of New York.

"Automatic Electric Welding Machines" (with experimental demonstrations), by Hermann Lemp, Jr., of Lynn, Mass.

Miscellaneous Business.

WEDNESDAY EVENING.

The members of the institute will be the guests of the Boston Electric club at a dinner, the hour and place of which will be announced on Wednesday. A paper will be read under the auspices of the club, by Stephen E. Barton of Boston, on "Central Station Insurance."

The headquarters of the club are at 7 Park street, where members will be welcome during their visit to the city.

Testing Apparatus for Telephone Exchange Switch-boards.

In telephone exchanges using multiple switch-boards as ordinarily constructed, in order to enable the operator to make the test to ascertain whether the line is "busy," the several terminals of each subscriber's line, located in the various boards of the multiple set, have been connected together by a normally-open supplemental or test circuit as represented diagrammatically in Fig. 1. A spring-jack socket *S* at each terminal

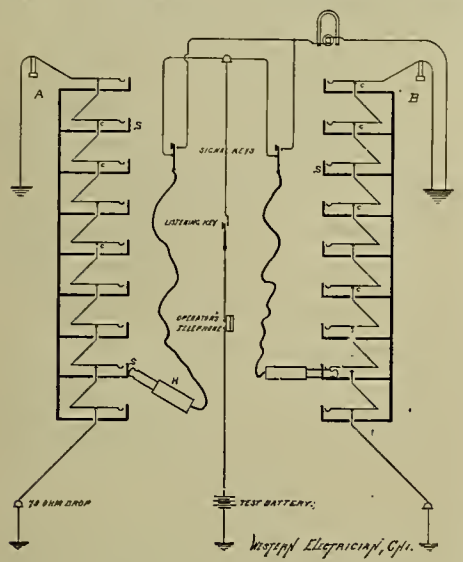


FIG. 1. TESTING APPARATUS FOR TELEPHONE EXCHANGE SWITCH-BOARDS.

was insulated from the body of the switch-seat. Through the sockets or test rings *S* the test circuit was established. In each operator's outfit a test-battery was arranged directly in circuit with the receiving telephone. Upon applying one of the switch-connecting plugs *H* to the test socket of the line to be called, all of the other sockets in the branch terminals of this particular line had a ground connection through the supplemental circuit. If such lines therefore were already in use through another board of the set, an electric impulse from the operator's test-battery would pass through the receiving telephone of the outfit and by the connecting plug and test circuit to the line terminal in use, thence to line, and so to ground at the subscriber's station, im-

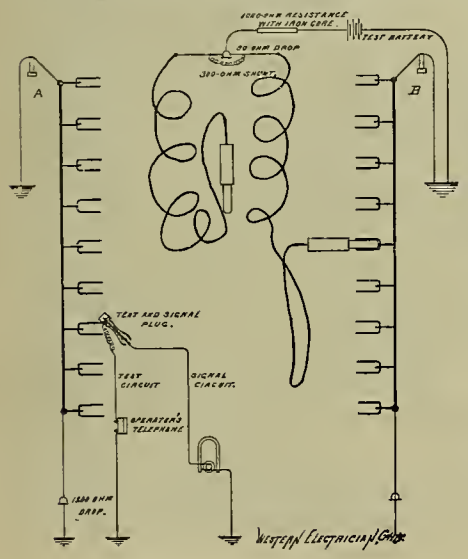


FIG. 2. TESTING APPARATUS FOR TELEPHONE EXCHANGE SWITCH-BOARDS.

parting a "click-signal" to the receiving telephone of the outfit, as is well understood. The presence of the battery in direct circuit with the operator's outfit made it necessary to employ special sockets as shown at each branch terminal of the series in the supplemental circuit. In order to improve on this system and avoid the complication indicated in Fig. 1, J. J. O'Connell of the Chicago Telephone company has invented the system illustrated diagrammatically in Fig 2. In this new system plain plug sockets which are used at the board make it possible to dispense with the supplemental test rings and circuit and trouble from dirty or oxidized contacts at *C* is obviated. Fig. 2 shows the connections of the testing outfit. From this it will be seen that three plugs are used. Two of these are used for making line connections, and the third plug is employed in connection with the operator's telephone, for testing, ringing up subscribers, and receivng orders. The subscribers' instruments are represented in both cuts at *A* and *B*. In the cuts a number of details have been omitted, but as the essential features have been designated it is thought that the diagrams will be self-explanatory. It may be mentioned that the inventor claims for this system that it may be applied with little change to metallic or mixed circuits.

The Largest Isolated Plant.

The city of New York has so long asserted her superiority over her sister cities, that she cannot reconcile herself to the thought of playing a subordinate part or stepping aside gracefully to acknowledge the justice of a rival's claims in any department of human interest. In spite of facts, she persists in her claims of preeminence with an earnestness and vigor that are often amusing. When a New Yorker does something remarkable in the eyes of his neighbors, the metropolitan press says it was never surpassed "in the country," for they argue there is nothing great or remarkable outside of New York. It is not surprising therefore that there were forthcoming the usual signs of calm self-satisfaction at the opening of the Metropolitan Museum of Art recently, when the structure was illuminated by 3,000 incandescent lamps. The New York papers gravely announced the following day that this installation was the largest isolated plant in the country. This is a curious mistake. The little town of Elgin, Ill., has a 5,000 light plant in its watch factory.

But this is not all. The gentlemen who visited the art display in New York, and were dazzled by the 3,000 light plant, would probably turn up their aristocratic noses if they were informed that there are two plants in the Stock Yards in Chicago of the same capacity and character as that which they considered a marvel in the Museum of Art. Doubtless, had they known of the existence of these plants in the packing houses of Chicago, they would not think of desecrating the temple of art by employing the same illuminating agent that guides the discriminating hand of the unerring pig-destroyer. The public building occupied by the city and county offices is illuminated by about 5,000 incandescent lamps. The Rookery building, used for commercial purposes exclusively, requires a 4,200 light plant. The Chamber of Commerce building has 3,800 lights, and this number will be increased shortly to nearly 5,000 lamps. The new Leiter building, not yet completed, will have 5,000 lamps, and the Wisconsin Central depot is another 5,000 light station. Office buildings with one, two and three thousand light plants are scattered throughout the business districts, and within a year larger plants than the "largest in the country" will be scattered all over the South side, where immense hotel and office buildings are now under way, which will require 3,000 lights and over.

This would be enough to show the absurdity of New York's claims, but when it is considered that its statement is made in the face of the fact that there are in the Chicago Auditorium over 12,000 incandescent lamps, ridicule gives way to pity for their lamentable ignorance.

Public Lighting in St. Louis.

It is estimated by the street lighting department of St. Louis that it will require an expenditure of $329,020.48 to light that city during the ensuing year. Of this sum $176,000 will be expended for electric lights in the streets and $38,000 for electric lights in public buildings. The salaries of the employes of the electric light department and incidental expenses of the office amount to $11,800. The remainder of the light fund will be expended in the gas districts.

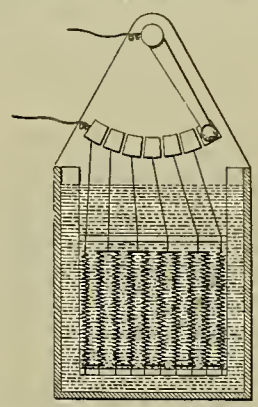
Park Commissioner Klemm has asked the Board of Public Improvements to prepare an ordinance appropriating funds for lighting the public parks by electricity.

Rheostat with Submerged Coils.

The accompanying illustration represents a form of rheostat which has recently been patented by Foree Bain, Chicago.

The peculiar feature of the device is the surrounding of the wire resistance coils with a liquid which has the capacity of carrying off the heat due to the passage of the current through the resisting medium, but at the same time will not materially reduce the electrical resistance.

The liquid used, which completely submerges the coils or sections of the resisting medium, may consist of water, oil, or other fluid, the essential requisite being that it shall be a non-



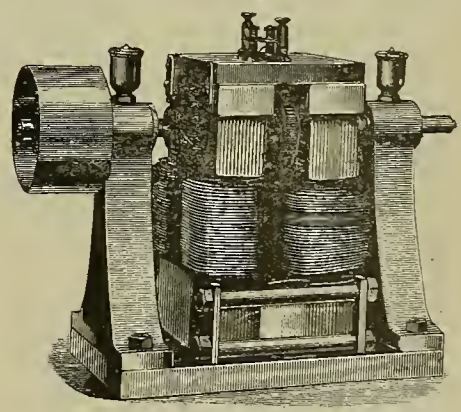
RHEOSTAT WITH SUBMERGED COILS.

inflammable fluid, and capable of carrying off or absorbing the heat generated in the resistance coils.

Mr. Bain states that he has found from tests that a resistance coil of, say, No. 20 iron wire submerged in a vat containing water is capable of carrying for an unlimited time a current of one hundred and fifteen amperes. While, of course, the water decreases the resistance of the coils he finds this decrease is very small, being practically not over two per cent. The carrying capacity therefore of the resistance medium is increased many times, as it is well known that a wire of this character exposed to the air will melt under the influence of a current of a very small number of ampéres. The water or other liquid carries off the heat that is generated by the passage of the current, and prevents the fusion of the wire. Moreover, in case the resistance should become overheated the fluid prevents the liability of setting fire to the surrounding materials.

Alternating Current Motor.

In the accompanying cut is shown a view of the alternating motor designed by Rankin Ken-



ALTERNATING CURRENT MOTOR.

nedy. The machine consists of two ordinary dynamos, with ring or drum armatures (drum armatures as shown in the cut), and laminated field magnets. Both armatures are on the same shaft, their coils being connected together. One of the machines acts as the motor, the other takes the place of the commutator; there are no brushes and no commutator, therefore no possibility of sparking.

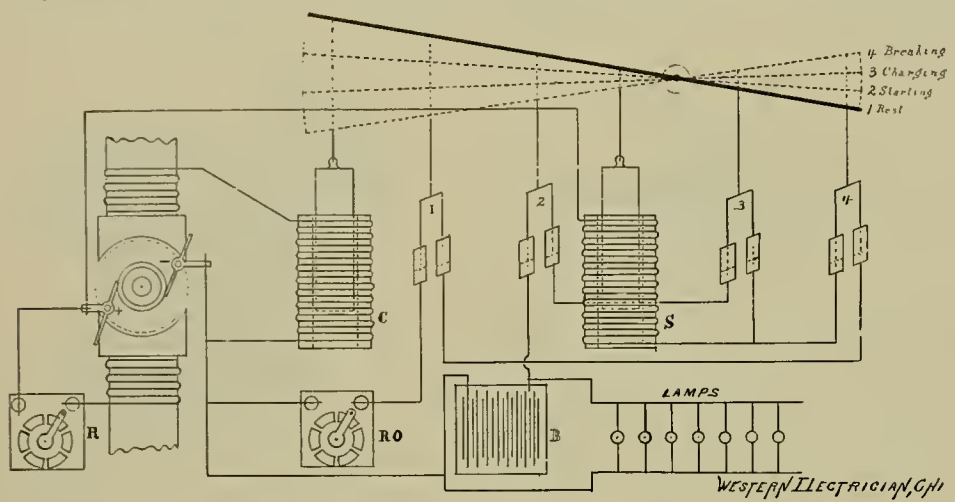
It requires two currents, one at a quarter of an alternation in advance of the other, but it does not require any synchronizing, and it can start with load on from rest; the two currents at

different phases are obtained from a transformer or two line wires with a third for a common return, or from a coil wound on the field of one of the combined machines. Larger machines are made multipolar. The cut is reproduced from the London *Electrical Review*.

Automatic Switch for Accumulators.

By Charles A. Pfluger.

The switch represented in the accompanying cut was designed by the writer to facilitate the charging of storage batteries. If this operation can be rendered automatic, it is manifest that the use of cells is made much more desirable and convenient. The automatic apparatus shown in the diagram is required to perform the following operations: First, if the dynamo is running at sufficient speed, the accumulators are switched on; second, if the dynamo is running too slowly, they are switched off; third, if the dynamo is running too fast, the batteries must be switched off; and fourth, they are switched off when fully charged.



AUTOMATIC SWITCH FOR ACCUMULATORS.

The switching apparatus, as shown in the cut, consists of two coils, *C* and *S*, with cores, a swinging arm or lever, with a counter weight, four pairs of mercury contacts 1, 2, 3 and 4, and a suitable resistance *RO*. The coil *C* is inserted in circuit with the field magnets of the shunt wound dynamo. It has from 100 to 200 ampere-turns in actual use. The iron core of this coil is attracted when the tension between the brushes of the dynamo reaches a certain point. The coil *S* is inserted in the positive conductor leading to the battery. It has only ten ampere-turns, and the core hangs at a point which is one-quarter the distance of the first core from the balancing point of the lever.

The swinging arm may assume four different positions, as shown by the heavy line and dotted lines in the diagram. First, the arm is at rest when the dynamo stops, and consequently no current is flowing through the coil *C*. The mercury contacts 1 and 2 are interrupted, and the mercury contacts 3 and 4 are closed. The second position of the arm is that which it takes when the dynamo is starting and is developing from 100 to 120 volts. The core in coil *C* is attracted and mercury contact 1 is closed. Contact 2 is open, and contacts 3 and 4 are still closed. A limited quantity of the current passes through coil *S*, then through contact 4, contact 1, resistance *RO*, and thence to the dynamo.

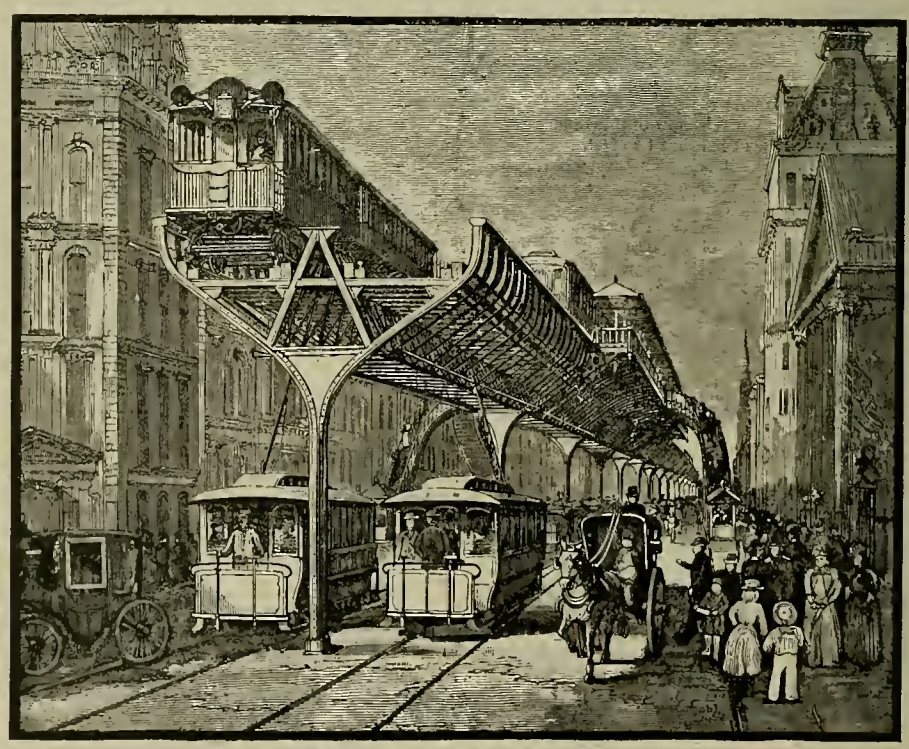
The third position is that of charging. The dynamo is running at from 100 to 120 volts, current is passing through coil *S*, attracting its core, closing contact 2 and opening contact 4, and entering the battery. Contact 3 is still closed. The fourth position is that which the switch assumes when the dynamo is running at too high speed; contact 3 is opened, and the main current to the battery is broken. The swinging arm assumes its permanent position, which must be released when the dynamo again assumes its normal speed. If the battery has been fully charged, its electromotive force is the same as that of the dynamo, and no current, therefore, is passing through coil *S*. The lever falls back into position 2 or 4, and is held by a mechanical device. The lever can be released at the switch-board if convenient. When lamps are used during charging hours, it will be necessary to employ resistance which, of course, can be inserted automatically.

It is almost unnecessary at the present day to speak of the fact that a storage battery installation is a most desirable and convenient means of supplying electric currents. Take the case of a country mansion, which it is desirable to illuminate by electric light. It may be very inconvenient to install a steam plant, but by using a storage battery it may be possible to utilize other power to great advantage. Water power can frequently be economically employed, and a turbine wheel, developing from 1 to 3 horse power, would in many cases be sufficient. Windmills can also often be employed to great advantage, though, of course, this power is extremely irregular. The plan of lighting a country house, such as has been referred to, might be arranged as follows: Suppose 30 incandescent lamps are required. Not over half of this number would be required at any time, and these would not burn over five hours on an average each day. Current is furnished by a battery which will have about 80 per cent. efficiency under ordinary circumstances. About 45 ampere-hours will be taken out of the battery, each lamp using 6-10 of an ampere at a hundred volts' pressure. It will be necessary to use 5,600 watt-hours to charge the battery, and for this work about 7½ horse power would be required. If the dynamo has an efficiency of 80 per cent., 9 4-10 horse power hours are required. If wind power were employed, the battery should be at least four times as large, because there will be days when there will be no power available for charging the cells. In this case, however, 200 ampere-hour cells would be sufficient. With such a storage battery plant and an efficient dynamo, the lighting of a small mansion could be effected with great success. It is manifest that the use of such switch as that described would be decidedly advantageous in such an installation.

Clarke Elevated Railway System.

In all city streets where there are two surface railway tracks there is a space between them of little use except for direct crossing. To utilize this space is the object of the elevated railway construction, shown in the accompanying cut. It will be noticed that the two elevated tracks are supported by a single line of iron columns, which are placed between the surface tracks at distances of about 80 feet apart. The columns carry triangular girders, to whose sides are riveted brackets, carrying the tracks, which are made purposely without cross ties and very open, so as to obstruct light and air as little as possible.

The brackets are extended above the tracks and carry longitudinal timbers which form safety guards, entirely preventing cars from falling to the street in case of derailment. The only question that can arise is whether the unbalanced weight of one car or one train of cars, with wind pressure added, can be resisted by a single post. To do this only requires that the post should be stiff enough not to bend, and the foundation large enough not to upset. With the light rolling stock proposed, it is claimed, this is not difficult. The column is embedded in a block of concrete during its construction. This block is all below ground, and can be made as large as necessary. The clear space left between street cars is about 28 inches, and an 18 inch wide post can be set between, leaving 5 inches clearance. This would require wire guards to be placed over the windows and along the inner side of platform, as is done on many cable roads. The superstructure is not designed for steam locomotives, but is especially intended for roads operated by electric power. It will be noticed in the cut that the surface car is electrically propelled; the overhead conductor is attached to the superstructure. The construction was designed by T. C. Clarke of New York. The cut was reproduced from the *Scientific American*.



CLARKE ELEVATED RAILWAY SYSTEM.

Self-Binding Cleat.

With the growing demand for improvement in electrical construction, new devices are constantly being placed on the market. One of the latest wrinkles is a self-binding wood cleat, which is illustrated in the cuts. Fig. 1 shows the cleat before it is placed upon the wires, the strap is turned aside and the lugs moved out of the way so as to receive the wires. When these latter are placed in position, the strap is moved back, so that its screw holes are directly over those in the lower portion. The cleats are then screwed in place, and when the wires are drawn taut, the lugs are pressed against them, holding

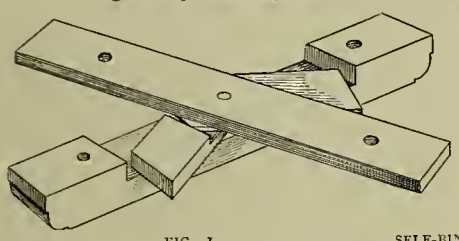


FIG. 1.

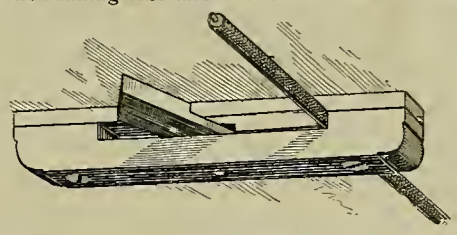


FIG. 2.

SELF-BINDING CLEAT.

the wires firmly. Fig. 2 shows the cleat with the wire in place. A number of these cleats can be put up and the wires tightened afterward with great facility, each cleat being, in fact, an anchor. They will take any size of wire from No. 14 to No. 10. These cleats are handled by the Central Electric company of Chicago.

St. Louis Electric Light Plant.

The new electric light and power station of the Municipal Electric Light & Power company of St. Louis, when completed, will be one of the largest, if not the largest, electric light station in the west. As stated in the last number of the WESTERN ELECTRICIAN, the plant was started May 1st. The station is situated near the corner of Nineteenth and Gratiot streets. The boiler room is located on the west side of Nineteenth street, and the engine and dynamo room are on the east side of the same street. The boiler room was planned and constructed under the supervision of Philip Roahn. The boilers are of the make of Roahn Bros., and great results are expected from them in the matter of economy of fuel and production of steam.

The cost of handling the coal has been reduced to a minimum, and herein lies one of the greatest sources of economy in the arrangement of the plant. The coal is handled by machinery from the time it leaves the car on the switching track until the residuum, in the shape of ashes, is again dumped on the car to be hauled away. What is ordinarily a large item of expense in the operation of an extensive plant is thus reduced to a minimum.

The main steam pipes leading from the boiler room to the engine pass under Nineteenth street, under which a tunnel was built for the purpose. The smoke stack is made of sheet steel, and stands 213 feet from the top of the boiler house. It is said to be the highest stack of the kind in the country.

The power house is a substantial four-story brick building on the east side of Nineteenth street. On the first or ground floor are located six 100 horse-power Hamilton Corliss engines built by the Hooven, Owens & Rentschler company of Hamilton, Ohio. From the driving wheels of these engines run the 48-inch main driving belts, which were made by Charles A. Schieren & Co. of New York. They run to the second floor where are located at present four rows of clutch pulleys extending along the entire length of the building. These pulleys were made and put in place by the Fall River Machine company of Cuyahoga Falls, O. Each row consists of 16 double surface pulleys connected directly to the dynamos located on the floor above.

On the third floor is the dynamo room. The machines are of the No. 8 Wood type, made by the Fort Wayne Electric company. Each dynamo is capable of supplying 60 lights when running at 875 revolutions and 3,000 volts. The current is 9.6 amperes.

The switch-board, which is located on this floor, is of a peculiar make. It is composed of strips of pine wood about one inch in width, set on edge. Between the strips are placed the phosphor bronze sockets for receiving the plugs. There are five rows of sockets, the space between them being filled with asbestos. Each circuit is provided with a Wood ammeter, which is located at the bottom of the board, while a current indicator, furnished by the Lockwood Instrument company of Detroit, is placed at the top. From the switch-board the wires pass to the fourth floor, where the lightning arresters are located, and thence to a tower or cupola on top of the building. Leaving it, the conductors go to a distributing point on the edge of the power house, and then branch into two main lines, one running east and the other west. On the fourth floor of the building is located the stock room.

The plant has been in operation now but a few days, but is already running satisfactorily. The construction of the power house was superintended by G. M. Viernow. The engines were erected under the supervision of Mr. Hooven of the Hooven, Owens & Rentschler company. E. L. Babcock superintended the erection of the clutch pulleys; Messrs. O. Reilly and Parker planned the dynamo room, and erected the switch-board. The line construction all over the city was done under the supervision of Mr. Heed. All the poles, both those of cedar and Norway pine, were furnished by C. W. Holmes & Co. The entire work was done under the general supervision of Jas. I. Ayer.

Chicago City Electric Light Plant.

The third power house of the Chicago city electric light plant has been completed, and the machinery is now being placed in position. The station is at the corner of Rice and Lincoln streets, and is a substantial brick structure similar in appearance to the other city power houses. For the present the plant will consist of four Brush machines, with a capacity of 200 lights. Only 115 will be used, however, this year. The territory to be covered by this plant includes Milwaukee avenue, from Desplaines street to North avenue, Wood street from Milwaukee avenue to Indiana street, and Indiana street from Milwaukee avenue to Wood street, making a circuit of over thirteen miles. The dynamos will be belted direct to two Ide engines. The plant will be started up May 25th.

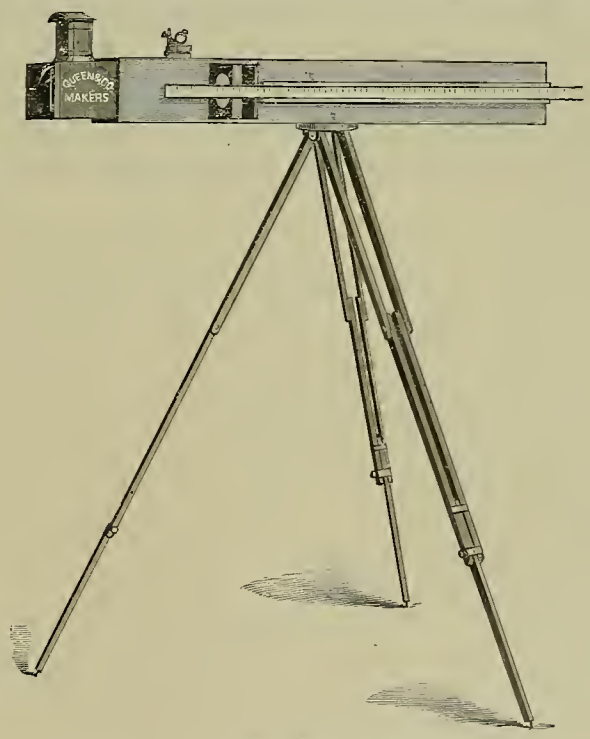
Accumulator with Gelatinous Electrolyte.

The *Electrotechnishe Zeitschrift* and many other papers have recently announced that the Oerlikon Engineering Works, Zurich, Switzerland, have been experimenting with an accumulator, the electrolyte of which is of a gelatinous nature, being formed by treating potassium or sodium silicates with sulphuric acid. The resistance, chemical reaction and method of charging, it is remarked, are about the same as in the usual form of accumulator. The efficiency of the cell is said to be from 80 to 95 per cent. It has also been stated that the value of the battery can only be estimated roughly until further details are made public. It may be added that the battery referred to, in which the solid electrolyte is used, is made under the patents of Dr. Paul Schoop, who gave many of the details of the battery in his article on "Accumulators for Galvanoplastic Work" in the WESTERN ELECTRICIAN of March 22d.

Portable Photometer.

To meet the demand created by the rapid adoption of the electric light for town and city lighting, and consequent necessity of making frequent tests for the purpose of conforming to certain standard conditions, the form of Bunsen photometer, shown in the cut, has been designed. The instrument is made especially for street work. The photometer is well made and exceedingly compact. It is 5¼ inches square in cross-section, and 38 inches in length, and is made of polished cherry. The lantern, as shown in the cut, slips into one end of the box, where it is firmly held; a small adjustable holder carries the standard light, which may be either one or two standard candles. This adjustment regulates the heights at which the flame stands and also its distance from the screen; by making this latter distance exactly one foot, computation is greatly facilitated. Distances are measured by a graduated bar which slides in grooves along the side of the box. To allow for the difference in vision between the right and the left eye, the instrument is made reversible—i. e., it may be turned completely over, so that the right eye observes the side of the disk before observed by the left, and vice versa.

When not in use the lantern chimney slips out and can be placed inside the lantern itself. The entire lantern box may be pushed inside the photometer, and the two ends and the sight hole of the instrument may be covered with small slides. A brass handle on one side makes it possible to carry the instrument as easily as a small hand bag. If desirable, a small incandescent lamp may be used as a standard instead of the candles. The range of the instrument is from about 4 candle power up. It has already been very successfully used in several tests involving expert opinions. The photometer is constructed by Queen & Co. of Philadelphia.



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W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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OUR Boston correspondent this week again reviews the action taken by the Massachusetts legislature on electrical measures. It is difficult to conceive how the law makers find time to transact any general business with the multiplicity of electrical bills crowded upon their attention.

THE daily press is again coming to the front with suggestions for abating the smoke nuisance in Chicago. There seems to be lamentable ignorance of the fact that, through the agency of the electric motor, power in practically unlimited amounts can be obtained in Chicago, and without smoke, dirt or noise.

ON the first page of this issue will be found an engraving showing the distribution of lights in the theater of the Chicago Auditorium. A number of views of this great hall have appeared, but up to the present time, we think it may be truly said, no cut has been presented that equals in accurate representation that in this issue.

THE organization of the directors of the World's Fair and the appointment of committees were effected last week. Mayor Cregier of Chicago was appointed chairman of the committee on electrical appliances and machinery, but he declined to accept the position as he feared he could not give the necessary amount of time to the duties of the office. This will be one of the most important committees, and its duties will require the undivided attention of its members. The mayor is a member of other committees and therefore deemed it inexpedient to assume the new position. It is to be hoped that an electrical engineer of prominence will be appointed to this position.

CITY ELECTRICIAN BARRETT continues firm in his belief of the advisability of the city assuming control of lighting plants. He believes that better service can be given the people at lower rates if the city assumes control of the plants. His remarks on the gas companies will prove interesting. It is well known that Prof. Barrett is opposed to the use of gas for illuminating purposes, and he is anxiously awaiting the day when gas will only be used for heating and culinary purposes. His views are presented elsewhere in an interview.

FOR some time there have been in circulation rumors to the effect that Ferranti's high tension system in London had developed serious defects. Just how great the trouble may be it is difficult to ascertain, owing to the conflicting accounts which have been published from time to time in the English electrical journals. To an American it seems most singular that these journals do not make an effort to get to the bottom of the matter. Electrical engineers in general are interested in the Deptford plant, and a reliable account of the progress made would be highly interesting.

IN another column is presented an article by Prof. F. B. Crocker of Columbia college, in which he describes a careful experiment which was instituted to determine whether the resistance of a conductor was affected even in a slight degree by changing the medium immediately surrounding it. The conclusion reached was that which was anticipated. The resistance was not altered in any appreciable degree. The result, though negative in its character, is, as Prof. Crocker states, important, "because the most prominent problem in electrical science at the present time is the action and relation of the electric conductor and the dielectric."

ENOUGH is heard of the mistakes of telegraph operators, whose alleged errors lead to lawsuits. As long as human telegraphers are employed, so long errors will creep into their work, but it is marvelous that in the rush of business, so few inaccuracies occur in the transmission of messages. In most cases an incorrect message is, at least, annoying, but in a cable dispatch from England, a story is told of an error in a telegram which proved to be a piece of unusual good fortune to the receiver of the telegram. The story is told of Lord Hammond, who recently died. In 1847 Mr. Gladstone offered him a baronetcy by telegraph, but by some mischance the word got changed in transmission to "barony," and before the mistake could be rectified Hammond gratefully accepted the proffered peerage. In order not to disappoint so old and faithful a servant of the public, Mr. Gladstone induced the queen to act as if no mistake had occurred, and Lord Hammond never learned till long after how much he was indebted to a telegrapher.

THE London *Electrical Engineer* makes the following startling statement: "One of the most interesting exhibits to electrical engineers at the Edinburgh Exhibition is to be a set of *three constant current motors run in series. It has been denied that this can be done successfully*, but we are to see these machines working at the exhibition. A Statter dynamo delivering 60-horse power will be used to drive three 18-horse power series motors. The generator gives 0 amperes and 1,000 volts—that is, will vary between the pressure required by the motors in all, up to the maximum of 1,000 volts. The current is absolutely constant. The motors are governed by shifting the brushes by an arrangement of dead-beat centrifugal governors." The italics are ours. Whoever wrote the lines quoted, manifestly has not visited the United States of late years. If he will make the trip over the water, or will even carelessly peruse American electrical journals he will, perhaps, discover that large numbers of constant current (arc) motors working in series on one line have been running in this country for years.

THE rivalry between St. Paul and Minneapolis is proverbial. A very striking illustration of the jealousy born of this competition is given in an article in another column in this issue. Extensive systems of electric railways are to be built by a company which controls the street car privileges in the twin cities. Public opinion demanded rapid transit by means of electric cars, for the cities are nothing if not progressive. The cable was not good enough for their enterprising citizens, so the company discarded the material which it had purchased with the idea of introducing that system, and determined to install electric motors. The work has been commenced, and now St. Paul fears that preference is given to Minneapolis; that construction is going on more rapidly in the latter municipality than within its own limits. Its expression of its fears, as voiced by a local journal, is reproduced in another column. We doubt not from all reports that have come from the two cities, that they both will be provided with ample rapid transit facilities. The management is not disposed to rush the work through, but proposes to construct its electric lines so carefully that they may serve as models for other cities. We are confident, therefore, that St. Paul's fears, though natural, are entirely groundless.

IN the argument before the Supreme Court of the United States for a review of the Kemmler case, a synopsis of which is presented in another column, the attorney for the prisoner gave notice of his intention to reopen the entire case with a view of showing that there was no guarantee that the execution under the new law would be instantaneous and painless, but rather, under the circumstances, that the preponderance of expert testimony showed it would be cruel and might be exquisite torture. Mr. Sherman said: "We propose to show that unless the current be applied in the best scientific manner there is not only danger, but a probability of prolonged torture, the most frightful ever devised by man, and that death will not be painless because not instantaneous." It is also contended that the provisions for solitary confinement, prohibiting the press from publishing reports, thus depriving the prisoner of a safeguard against cruel punishment, and of withholding from the condemned man the exact date of the execution, were additional punishments, and essentially unconstitutional. The argument on these points will be made May 19th, and will be awaited with interest not only by the electrical fraternity, but by humanitarians and scientists throughout the civilized world.

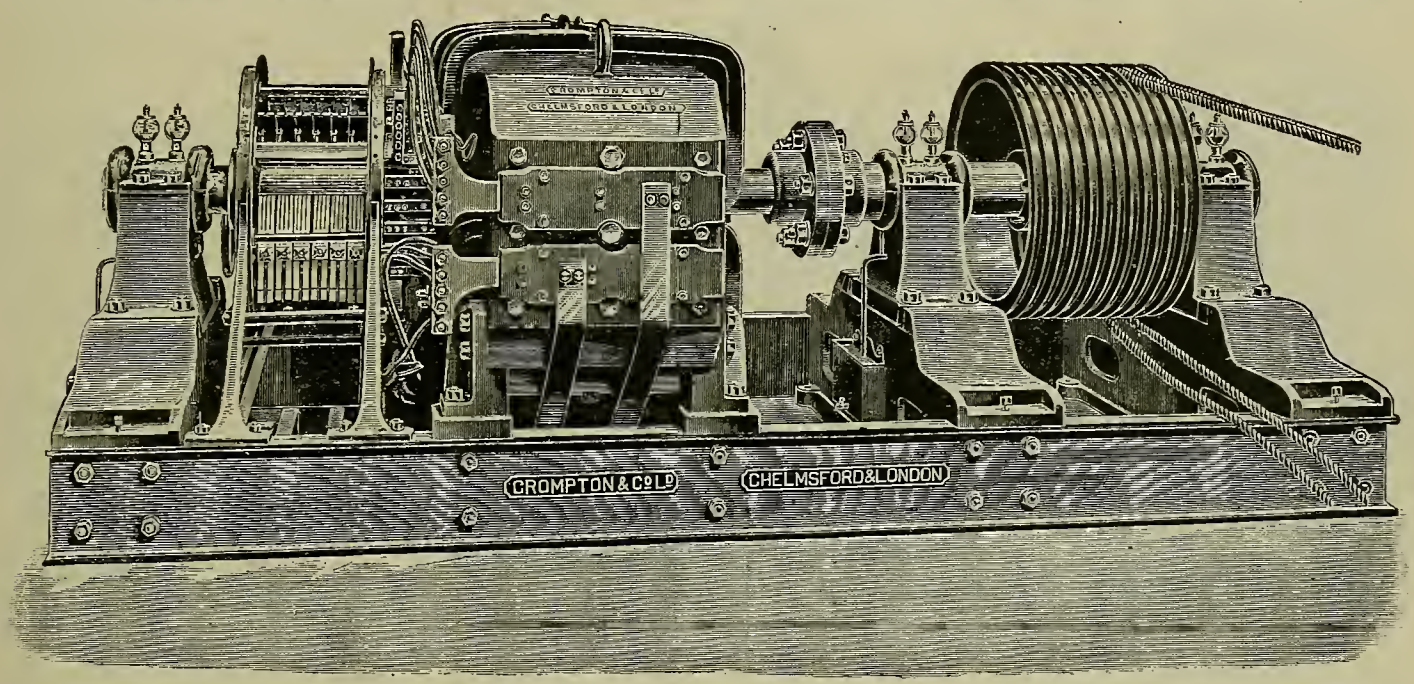
The charge that money had been used in the New York legislature to secure the adoption of the bill abolishing capital punishment has been freely made by sensational journals in the metropolis, and as freely copied by contemporaries throughout the country, but thus far not the slightest evidence has been produced to substantiate the accusation. On the contrary, there is every reason to believe that the action of the legislature fairly represents the prevailing opinion in the Empire state at the present time, though it can scarcely be said the people would not be clamoring for a re-enactment of the law in some form at the first outrage which would come to their notice. The present condition is the result of the constant agitation on the part of the electrical fraternity since Kemmler was sentenced over a year ago. The people have become disgusted with the horse play and advertising tactics that have been resorted to by those intrusted with the preparations for the terrible event, and it is no wonder that they decided to abolish capital punishment entirely. The advocates of the measure included the leading philanthropists of the day, and many eminent men appeared before the senate committee and urged the adoption of the bill passed by the assembly. The hue and cry of corruption raised by sensational newspapers had had its effect, and the bill was not sent to the governor.

Four-Pole Drum Dynamo.

The four-pole drum dynamo recently constructed by Crompton & Co., Chelmsford, England, is shown in the accompanying cut. The machine has an output of 50 volts and 2,500 amperes at 400 revolutions per minute. The armature has 48 external conductors of 185 strands of No. 16 B. W. G. twisted and compressed into a rectangular cross-section. The armature diameter is 22in. It is built of disks keyed to a soft steel spindle. The spindle is made in two parts, coupled by a cast iron coupling, and fitted with a pulley for rope driving. There are three bearings, and these have only the bottom brasses lined with white metal. The magnets are wound with thirteen layers of copper strip 0.19in. by 0.24in., resistance cold 0.9 ohm, all in series. The magnets are 26in. by 11½in. There are four sets of six brushes each. The opposite brushes are coupled together in parallel. Each brush is 2in. wide. The machine is mounted on a bedplate built up of two channel girders of wrought iron, to which the pedestals of the magnets and the bearings are bolted.

The armature conductors have faced joints, and are screwed together with steel bolts and nuts. The whole armature can be stripped in four hours. It does not require much longer to put it together, and replace the bands. A repair, if necessary, could be executed in a very short time, unless, of course it was necessary to take off the bands. This dynamo was designed for smelting work.

Industries, from which the cut is reproduced, says in regard to the machine: "We feel confident that the single magnet two-pole drum dynamo now in almost universal use will give way to the four-pole type for the larger sizes of generators. The four-pole machine seems to have everything in its favor. The end couplings, which are the most troublesome part of two-pole machines, are beautifully simple when four poles are used, as the connections are only a quarter round the armature, and do not tend to foul the spindle or to block up ventilation spaces. Besides this, they are infinitely more accessible, a point of great importance with reference to repairs. If a four-pole machine has the same number of active conductors, the loss by hysteresis in the armature is approximately the same as in a two-pole machine, for, though the iron is reversed twice as often, there is only about half the volume; or if, on the other hand, the radial depth is kept as before, the induction is very much lower. For large currents the four pole drum is especially suitable, as the current in each conductor is one-fourth of the whole current, and the commutator sections are more numerous than in the corresponding two-pole machine."



FOUR-POLE DRUM DYNAMO.

The Influence of the Medium upon Resistance.

By Francis B. Crocker.

It has been well known that the dielectric or medium in which electrified bodies are immersed plays a very important part in electrical phenomena. The early experiments of Faraday showed that the action of electro-statically charged bodies upon one another is greatly affected by the nature of the medium between them. The recent experiments of Hertz show that the propagation of electro-magnetic disturbances is also influenced by the character of the medium. Such being the facts the question very naturally arises whether the resistance of an electric conductor might be affected even to a very slight extent by changing the medium immediately surrounding it.

With the object of definitely answering this question an experiment was recently performed at the suggestion and under the direction of Dr. Pupin by Gano S. Dunn, student in electrical engineering at Columbia College. The fact that standards of resistance, as those of the British association, have often been surrounded with paraffine, at first made the experiment seem unnecessary; but it was remembered that the wires of the standards were very carefully and tightly wrapped with several layers of silk, which might keep the paraffine away from the surface, which is by far the most active region, and also that, to our knowledge, no experiment has ever been made with this sole object in view. Two platinum wires, about No. 25 B. & S. gauge, each having a resistance of 2.84 ohms, were formed into helices and cleaned by glowing over a Bunsen flame. Insulated copper wires passing snugly through a rubber stopper were soldered to the ends of each helix. Each helix and stopper was then inserted in a test tube and both test tubes into one water bath.

The "slide meter" Wheatstone bridge with low resistance Thomson galvanometer was used, in which bridge the helices described formed the other two arms. It was found impossible to entirely eliminate errors due to thermo-currents, a difficulty which was encountered by Professor Chrystal when comparing the B. A. units in 1876. In order to make these errors as small as possible the scale with its lamp was placed at a distance and read by a telescope near the observer; and the bridge was entirely covered with three or four layers of tissue paper to keep its parts at equal temperatures. The whole apparatus after setting up was allowed to stand for twenty-four hours that it might reach its normal temperature. The temperature of the water-bath was approximately the temperature of the air. The measuring current passed through the helices did not exceed 1-30 ampere, and was of short duration.

The bridge was balanced and after ten minutes was again observed, to see whether it had remained so. Without being disconnected one of the test tubes was then lifted out of the bath, filled with melted paraffine, cooled for five minutes in another bath, and replaced. At the end of an hour the balance was found to be restored to within three or four divisions of the scale, and when observed the next day to within two divisions. The balance was then destroyed by moving the slider one millimeter, corresponding to a change of resistance of 0.4 per cent.; this gave a deflection on the scale of eighty divisions; and since the deflection before was less than two divisions, we may say that the change of resistance, if any, was less than 1-40 of 0.4 per cent., or less than 1-100 of 1 per cent. This difference is of course within the limits of experimental error, therefore we conclude that the resistance of an electric conductor is not altered to an appreciable extent by changing the medium immediately around it from air to paraffine.

This experiment, though negative in its results, as we expected it would be, is nevertheless worthy of record, because the most prominent problem in electrical science at the present time is the real action and relation of the electric conductor and the dielectric, and any work bearing directly upon this question is important. Whatever this relation may be, it would appear that it is not such that the electrical resistance of a conductor is modified to any extent by the presence of different media. It may be well to point out, however, that our experiment was only tried with continuous currents produced by the ordinary gravity battery; with alternating currents, the results might be different.

Fire at the Knapp Electrical Works.

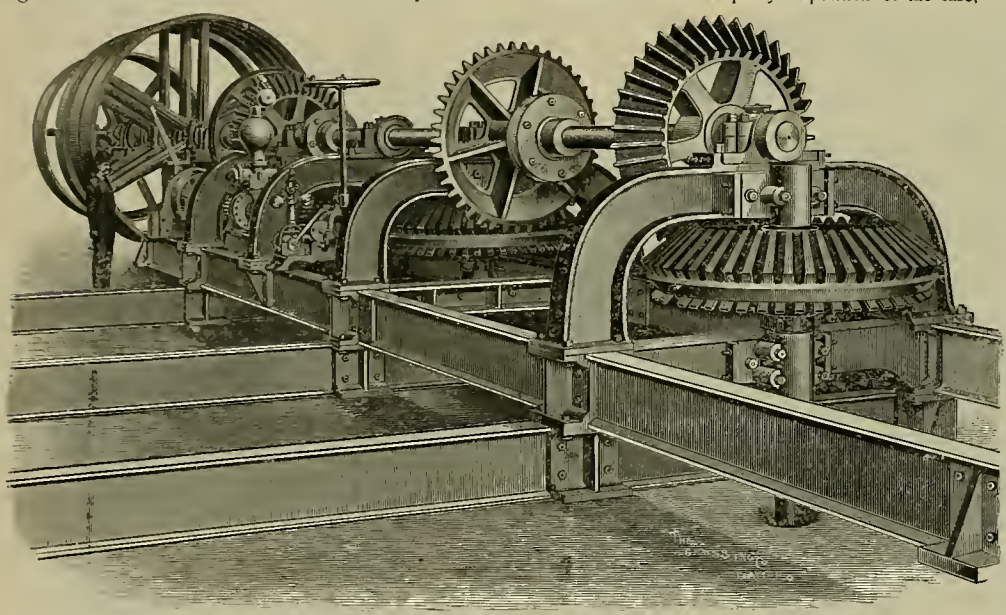
Fire was discovered Tuesday morning about 3 o'clock in the factory of the Knapp Electrical works at Chicago. The fire started on the third floor and communicated with the floor above. The fire department was soon at work playing upon the flames, but before the fire could be controlled the machinery and stock throughout the building was thoroughly wet, and the damage from water exceeded that caused by fire. The building was stocked from cellar to garret with wire, electrical appliances of all kinds, annunciators, etc., and the damage from water will necessarily be large. A portion of the machinery is ruined.

Myron A. Knapp, manager of the works, was in New York City when the fire took place. He was at once notified and immediately started for home. The extent of the damage cannot be estimated until his return, nor can any definite statement be made as to the loss sustained. It is believed that the damage is entirely covered by insurance.

Utilizing Water Power.

The fact that by the use of electric motors the power of waterfalls may be made available at a considerable distance has awakened within the last few years a marked interest in water wheels. Especially is this true in the west, where some new plan for using the power of a fall which has hitherto gone to waste comes to hand almost daily. In the accompanying cut is shown the arrangement of the gearing in a power plant recently installed by the Stilwell & Bierce Manufacturing company of Dayton, O. In many cases where turbines are employed for ordinary milling purposes the gearing which connects the wheels with the shafting proper is supported on wooden framing. Where, however, the power is to be applied for the production of the electric current, greater refinement in construction is required. To meet this demand this firm has placed on the market the gearing referred to.

In the installation which we illustrate, three Victor turbines are used. All the framing for the gearing is of iron, and is disposed in a manner to secure the greatest rigidity. This feature will be appreciated by those who have had experience with wooden framing. The speed of the wheels is controlled by a peculiar form of governor. This is one of the most important features of the power machinery, as upon it, to a great extent, depends the efficiency of the plant. The general construction of the governor is shown in the cut.



UTILIZING WATER POWER—VICTOR TURBINES.

Rapid Transit in St. Paul and Minneapolis.

The appended extract from an editorial in the St. Paul *Pioneer Press* illustrates how jealous the twin cities of Minnesota are of each other. The superiority of the electric railway is generally recognized, and St. Paul seems to be afraid its rival will get more than its share of attention from the street car company operating in the two cities. The extract follows:

Work is going forward actively in Minneapolis. The dirt is flying, and crowds of laborers are engaged in providing the new facilities for street travel. In St. Paul there is some movement along the University avenue line, and we are told that iron is on the way for the trifling bit of road from Rice street and Como avenue to the junction of Como and Front street. Except for these assurances, nobody would suspect that St. Paul was to have the electric system that has been promised us so repeatedly and solemnly.

We fully appreciate all the difficulties that have to be surmounted, and give to the management of the street railway system due credit for earnest effort to do what the people expect. An enterprise like this involves extraordinary labor. The raising of the necessary capital, though in itself an immense undertaking, is, perhaps, the smallest item. There are scores of contracts to be concluded, each one of them involving the purchase of material and appliances whose relative efficiency is scarcely yet ascertained. And all the companies in the country engaged in the manufacture of supplies for electric railways are so rushed and crowded with orders, by reason of the sudden and immense demand for the introduction of electric motors on street railways, that they cannot supply the demands made upon them. Knowing this, the public will be inclined to make any allowances necessary to the street railway company, as long as they are assured that there is no willful neglect. But what they do ask and expect, and have a right to ask and expect, is, as we have said before, that the two cities be treated equally in this matter. St. Paul needs the immediate substitution of electricity for horse power on every line. She needs the construction of every foot of road mentioned in the railway company's ordinance. And one has but to patronize the Grand avenue line, now in operation, in order to understand how imperatively she needs the addition of extra cars on existing lines, and a more liberal and frequent service. Her people cannot command Mr. Lowry to accomplish the impossible. They expect more of him, perhaps, than they would of a man less accustomed to success and less brilliant in his business operations. But they will have fair treatment, and they are watching the progress of street railway improvements in the two cities very carefully to see that they get it. If all that has been promised can be performed, nobody can complain. But if there should be any default, and the little that has been done up to this date, when the season is far advanced, seems to point that way, they will be found in a rather uncompromising mood if they have not been given their fair share of additions, extensions and improvements in the street railway service.

Proceedings in Kemmler's Case.

A brief announcement was made in the last issue of the WESTERN ELECTRICIAN of the disposition of the Kemmler case which will be considered by the Supreme Court of the United States, May 19. The petition relates the circumstances attending the conviction and sentence and continues: "The statute also leaves it to the warden to fix the day and hour of his death, and contains other features which he here asserts are in violation of the Fourteenth Amendment. These features abridge his privileges and immunities as a citizen of the United States, and deprive him of his life without due process of law."

Roger M. Sherman, who appeared for the prisoner, said he desired to facilitate the speedy disposition of the case, and therefore preferred a writ of habeas corpus, returnable May 19 rather than a writ of error which would keep the case open until October, and possibly might not be finally determined for a year. It was contended, he said, that the infliction of death by electricity was a cruel and unusual punishment, and that the limited privilege or immunity under the Eighth Amendment was by the Fourteenth Amendment extended and protected from encroachment by the state. He further maintained that even if the Eighth Amendment did not exist the writ should still be granted under the Fourteenth Amendment, on the ground that it deprived the prisoner of his life without "due process of law," by inflicting cruel and unusual punishment.

Justice Field—If it be instantaneous it cannot be cruel.

Mr. Sherman—That is an assumption of fact. We propose to show that unless the current be applied in the best scientific manner there is not only danger but a probability of prolonged torture, the most frightful ever devised by man, and that death will not be painless because not instantaneous.

Continuing his argument, counsel expressed the belief that any infliction of sudden death must be more or less cruel. Even though electricity might inflict an instant death, he contended that it was unusual and therefore unconstitutional. But there was a great deal of testimony tending to show that whether death would be instantaneous or prolonged depended upon the manner in which it was applied. On this point there was a great difference between this new law and the old. The old law of hanging prescribed the mode by which it should be done, and the time. It did not authorize the warden to go into the prison at any time within a week and there inflict death with a rope in any manner he saw fit. This new law authorized the warden to kill the prisoner any time within a week, and gave him authority to provide such a current as he thought sufficient to kill him. The law did not even require the warden to be an expert in electricity. It was entirely consistent with the law that he might not only not be a scientific man, but might have no qualifications whatever. It was entirely within the discretion of such a man to determine that 500 volts will be sufficient, and to begin with that current. The concurrent opinion was that 500 volts would inflict the most searching torture the ingenuity of man ever devised; that it would seek out the nerves and vital places, and that life would finally be given up as the result of exhaustion.

Mr. Sherman also spoke of the provisions for solitary confinement, prohibiting the press from publishing reports which deprived the prisoner of a safeguard against cruel punishment, and of the withholding from the prisoner of the date of his execution, a provision which, he insisted, deprived the prisoner of "due process of law." The case of Medley, the colored murderer, who was released on writ of habeas corpus, based on the ground that solitary confinement, suspense as to the exact date of death, etc., were additional punishments, had gone pretty far in the direction of Kemmler's contention. In that case Justice Miller had held that the grant to the warden of direction as to the time he should hang the prisoner was a departure from the law, as it had always existed up to that time, and that it was not an unprejudicial, but a prejudicial change, and ex post facto and void.

Justice Bradley called attention to the fact that the Medley law was passed after the commission of the deed, and that it was ex post facto.

Mr. Sherman said that there was no contention that the law in Kemmler's case was ex post facto; but his contention was that when a law of this character is held to be a material and prejudicial change against the condemned man, it must, by a parity of reasoning, be held to be a departure from due process of law. It was a departure in one sense, because it is a departure from all settled law prior to the passage of the act. He thought that he had now shown enough in a case of so much magnitude, in a case which is such an entire innovation, to contend finally with some confidence that these provisions ought not to become a part of settled law on a refusal to examine into these questions by the denial of a writ.

To secure the granting of the application for a writ of error, it is contended, it will be necessary to show that a federal question was involved in the conviction and sentence of Kemmler—in other words, that the proceedings conflicted with the provisions of the Constitution of the United States.

The question as to the right of the warden of the state prison to execute Kemmler will be argued probably in June. At Auburn last Saturday the first step was taken when the writ of habeas corpus issued by Judge Corbett was returnable. W. Bourke Cockrane, who appeared for Kemmler, said: "The point now made is that the sentence is in violation of the constitution in the following respect: That the sheriff is a constitutional officer, elected by the people; that one of his powers from time immemorial has been to execute capital punishment upon criminals condemned to death, and that the legislature cannot take away those powers and delegate them to the agent and warden of the state prison, who is an appointed officer, without doing violence to an article of the constitution."

Mr. Cockrane then stated that this application was made, not for delay, but in good faith, and in order to get a final and speedy decision of this question, with the consent of the attorney general, a *pro forma* order should be granted now overruling his demurrer, and remanding the prisoner, and that an appeal should be taken at once to the General Term of the Supreme court, where the order now made should be reaffirmed immediately upon the meeting of that court in June, and an appeal from that decision taken at once to the Court of Appeals, where the matter might be argued and finally decided, some time in June.

The attorney-general said that he should interpose no objection to the step proposed, which tended to expedite matters.

It was then ordered by Judge Underwood, in accordance with this understanding, that the demurrer to the return be overruled and the prisoner remanded to the custody of the agent and warden.

Storage Batteries at the Palmer House, Chicago.

The Electrical Accumulator company, New York, has just completed an interesting installation of 120 cells of storage batteries at the Palmer House, Chicago. This increases the capacity of the plant to 1,000 lights, and the system is extended to the barber shops, Turkish baths and halls of the hotel. The plant comprises four incandescent dynamos and three arc machines of the United States company make. They supply current to the offices of the hotel, dining rooms and parlors, but not to the sleeping apartments. Mr. Palmer now has under advisement a project for supplanting gas in all parts of the hotel. He is a believer in storage batteries, and his experience, he says confirms his belief in the efficiency of the system. A year ago he began lighting his palatial residence by storage batteries, and when he desired to extend the hotel plant, he immediately determined to employ the same agency. Accordingly, he placed an order with William Hood, Chicago, representative of the Electrical Accumulator company.

Electricity and Music.

Electricity has been an important factor in the operation of a great organ's curious mechanism for many years, but few people outside the musical profession have understood it. The fact that electric motors have been used for working the bellows that supply air to the pipes is common knowledge; but that the action of organs is conducted in the same manner seems to have been unwittingly kept a secret by performers and builders. Experiments in this application of electricity were begun in Germany during the '60s, and the introduction of it in American-built organs was accomplished in 1869. The method then employed was very crude compared with the present system, by which every effect desired by the player is attained by the aid of electricity. In Grace church, New York, there are two organs, one in the chancel, the other in the gallery 150 feet away. Every key, pedal and stop in the small chancel organ is connected with the big organ in the loft, and the performer at the chancel organ by means of a switch may

operate at will both organs simultaneously, or only the smaller. When the new chancel organ was put in, the original key board and pedals of the old organ were left undisturbed, and to-day when the old organ is operating it presents the ghostly phenomena of the stops, keys and pedals moving without the apparent application of the hand. One of the main reasons for the employment of electricity in organ action is the saving of time between the pressing of a key and the corresponding answer from the pipe. This time in the best mechanism is inconsiderable, but to musical ears it is sometimes noticeable. In addition to the incomprehensible speed of the electric current, modern organs are so constructed that compressed air does all the work of admitting air to the pipe chambers and of closing the vent when pressure from the key is removed That is, the wind chests are constantly full of compressed air, which, by mechanism too intricate to describe without numerous diagrams, acts and reacts upon the valves without interfering with the operation of the keyboard.

Westinghouse Railway System.

The North American Construction company of Pittsburg, Pa., has decided to engage in railway construction work under the Westinghouse system. E. H. Wells was in Chicago last week, and he said the company had just concluded its arrangements for engaging in this department on a most extensive scale.

The Westinghouse system will be an overhead construction. A special motor adapted to railway work will be used.

Naval Battle of the Future.

In the May number of the *Forum*, Bradley A Fiske writes of the "Naval Battle of the Future." Warfare on the sea, he says, has been entirely revolutionized by the fact that modern inventions, among which electric devices are not the least, are utilized to such an extent on shipboard. He speaks of an encounter between two ships as follows:

In the event of a war between this country and any great commercial power, a prominent feature would be the dispatch of swift, unarmored, but well-armed, cruisers, to prey upon the commerce upon which the enemy's greatness rests. Many of the merchant steamers of the enemy would be armed with a few rapid-fire guns, but their engines and boilers being above the water line, they could defend themselves against similar merchant steamers only. A cruiser meeting one of these crafts would have an easy victory, if she could catch her, or hit her with a shot from one of the six-inch or eight-inch rifles. But suppose she meets a similar cruiser of the enemy bound on a similar errand; a struggle to the death is the only possible result. Each will clear for action as soon as the other is discerned—perhaps five miles away. Each will probably slow down at first, in order to gain time for preparation, and especially for getting the steam pressure up to the highest point. Forced draught will at once be started, and the subdued roar of the air driven through the furnaces, to accelerate combustion, and the whirr of the dynamos, will be added to the clang of the gun-breech blocks, as they are swung open to admit the projectile to the breech, the hum of the ammunition hoists raising powder and shell to the decks, and the quiet, firm orders of authority. On deck, the Gatling guns and revolving cannon, and the rapid-fire guns in the tops, are got noiselessly into readiness; the captain takes his place in the armored conning tower, with the chief quartermaster and his aid; the executive officer assumes charge of the battery, and remains near at hand to take the captain's place in case of his death or disability; the range-finders are got into position, and the officer in charge begins to report from time to time the distance of the enemy, now drawing closer.

Probably not a shot will be fired until this distance is reduced to 2 000 yards, and probably both ships will keep pointed toward each other until that time. But now what will the contestants do? It has been held that both will advance steadily toward each other—each commander hoping that some false move on the part of his adversary will enable him to rush forward, discharge his bow torpedo at 500 yards, and perhaps follow it up with his ram and end the fight at once — until they have approached so close, say 500 yards, that neither dares to swerve lest he himself be rammed, and that the ships will at length collide end on, and possibly both sink! This seems absurd, yet is it impossible? But if one commander feels great confidence in his gunners, and especially if the sea is smooth, he may turn his broadside toward the enemy, so as to bring his guns to bear in the most effective way, and begin a careful cannonade, knowing that one well-placed shot may rake the enemy fore and aft and disable his best gun. In case the enemy adopts similar tactics, fearing the effect of a fore and-aft raking fire, a long-range duel may be kept up, until one or the other scores a sufficiently effective shot to warrant closing and trying the torpedo and then the ram, each hoping meanwhile to get in a heavy shot near the water line, as the adversary rolls the other way. But in case both elect a closer range, we may see the Kearsarge and Alabama duel re-enacted, each vessel steering toward the other until so close as to fear a raking shot, then sheering off toward the other's stern—not her bow, for fear of being rammed—and then each going ahead with the helm over, describing a circle with a common center. If the contestants, while possessing about equal strength, differ in one being stronger in fore-and-aft, and the other in broadside fire, the former may keep pointed toward his adversary, using his bow guns, while the latter will reply with the full strength of his broadside. But should this broadside fire fail to stop the other's advance, it must soon be discontinued, and the bow turned, to avoid being rammed in the side. Here the judgment of the commander will have its fullest test, for if he delays too long—if he delays, for instance, until the distance is down to, say, 500 yards—he will not have time to turn his bow, and will certainly be rammed and sunk. He must know to a nicety the exact turning power of his ship, and must keep careful count of the distance, so that, while using to the utmost the power of his formidable broadside, he will always reserve ability to turn his ram to the enemy. He must allow a margin, too, lest a sudden, even a temporary, accident or disablement to the engines or the steering gear should leave him helpless at the critical instant. The weakness of the side of the ship, and the time required to turn, which is, on the average, almost two minutes for 90°, show the advantage of bow fire, and of protection on the bow against a raking fire

Electric Omnibus.

It will be remembered that we created a great deal of interest, not only in this country, but in America and on the Continent, by the announcement of the trial running of an electric omnibus in the streets of London, says a London paper. We are now able to state that in a few weeks a line of electric omnibuses will be established, and commence running for passenger traffic as ordinary omnibuses without rails from Charing Cross to King's Cross. The route will be up Regent street and along the Euston road, so that the fashionable world as well as the workers will have a chance of seeing and riding in the cars. The omnibuses will have 16 feet bodies, much of the same size as the usual ones, but less in total length, taking in equal about half the length of the horses. Six inches more in seats will be allowed to each passenger, a comfort to be largely appreciated Seats will be both inside and out, and 26 passengers will be carried in each. There will be six omnibuses on the route, and a charging station is being erected at King's Cross. The omnibuses are on the system devised by Mr. Radcliffe Ward, and driven by accumulators. Electric delivery vans for heavy traffic will also, it is expected, be introduced, and charging stations will probably be erected at various convenient business centers. An electric butcher's cart is now practically finished, and has been constructed for, and will be used by, a well-known pork butcher.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 10.—The last days of the electrical exhibition at the Lenox Lyceum are bringing together immense throngs of interested spectators, who are able to catch a glimpse of the wonders of electricity, and form a small idea of the advancement in the solution of the numerous problems which is being made, even by a single mind. Glimpses of the "twentieth century," the talking dolls and the electric railway are attractive features of the exhibit, but perhaps the most welcome attraction was the presence of Mr. Edison. He received an ovation the evening especially devoted to him, and even the musical program was arranged with this thought in mind, as the "Phonograph Waltz," composed for the occasion, was a prominent number.

Direct communication between New York and Nicaragua was established yesterday. A telegram to the Nicaragua Canal Construction company reports the arrival of a North River tug, the "Millward," at Greytown The route of the telegram was from Greytown to Castillo on the San Juan river, thence to San Juan del Sur on the Pacific, where the Central and South American Cable company's line runs to Salina Cruz on the west coast of Mexico, thence across the isthmus of Tehuantepec to Coatzacoalcos, thence by cable to Vera Cruz, to Galveston, and over the Western Union wires to New York.

Ganz & Co. of Buda Pesth, Austro-Hungary, have begun a suit in the United States Circuit Court against the Edison Electric Light company for damages to the amount of $500,000. The Edison company bought the Zipernowsky-Deri Blathy system of distributing electricity by means of an alternating current for North America, and inasmuch as the Edison company have not found it advantageous to install this system, Ganz & Co., who are the owners of the European rights, claim that the injury to their interests abroad is directly owing to the indifference of the Edison company in not making an effort to defend their patents, which are said to infringe United States patents on alternating currents, but which Ganz & Co. believed could be sustained in the United States if the proper effort had been made by the Edison company.

The experiment of lighting the Metropolitan Museum of Art by electricity has proven entirely satisfactory, and will be a relief to the art-loving public who visit this collection during the summer months. The immense halls and spacious galleries were flooded with light from 3,000 incandescent lamps, well arranged in clusters under reflectors and supplied by four large dynamos in the cellar of the building. Now that it is proved that the collections can be inspected by artificial light, the museum will be opened to the public on Monday and Thursday evenings of each week.

The question of abolishing capital punishment in this state has attracted considerable attention during the last week. The Curtis bill passed the Assembly by seventy-five affirmative votes, and there were seven members pledged to support the measure who were not present when the bill was called up. Less than half that number, went on record as opposed to the act. This unlooked-for result greatly surprised the metropolitan press, and charges of corruption and bribery were made, and it was further charged that electrical concerns were interested in rushing the bill through. The manly denial of George Westinghouse, Jr. has silenced the traducers of the electrical fraternity, but they persist in their silly talk about the bill being railroaded, etc. To these charges Mr. Curtis, who introduced the measure, says: "This bill has been introduced by me in each of the seven sessions of the legislature of which I have been a member, and I would call attention to the fact that in the present session it was introduced on Feb 4 and referred to the committee on codes; that it was considered in that committee about four weeks, and at least one hearing given on it; that it was reported for the consideration of the house, went on general orders, was twice considered in the committee of the whole, debated by the introducer in the first committee and made a special order for the second, when it was debated by its friends, no one having any arguments to offer in opposition to its passage. It went to a third reading, came up regularly in that order, and on account of the absence from the house of many of its supporters, it was laid on the table, where it remained about two weeks, subject to be called up by its introducer, to do which no notice is required by the rules of the assembly. This is a course frequently practised in both houses." This should set at rest all statements of the misinformed correspondents and unreliable newspaper writers. W. H. T.

St. Paul, Minn.

ST. PAUL, May 10 —The street car company has started work on a new electric line to take the place of the old Lafayette and Greenbrier horse car system. Since the East Seventh cable has been in operation the cars of this line have been attached to the cable train at Wabasha street and hauled to Locust street, where horses were attached, to pull the cars the rest of the road to the barn on Greenbrier. Under the new arrangement this system will connect with the present Oakland avenue electric line. A large force of men is now engaged laying rails on Tenth street and Broadway, the intention being to have the new line start from the terminus of the Oakland avenue line on Fifth street, running along Broadway to Tenth street to Lafayette park where connection will be made with the old line from that point to Greenbrier avenue. The rails are now laid on Tenth street, and on Broadway from Tenth to Ninth, and will probably reach Fifth street by Monday night, as the work is being pushed very rapidly.

There has been some delay owing to the non-arrival of some of the wire, but it is expected to reach here every day, and will be put in position before the ballasting of the line is completed. When the poles and overhead wires are erected the line will be put in operation, and the Lafayette avenue cars will be taken off the cable line. Then passengers for the Arlington Hills district can take any of the Oakland avenue electric cars going toward Smith Park and will there be transferred to the new line. The complete route of the line now under construction will be from Fifth street via Broadway, Tenth, Locust, Lafayette avenue, Collins, Burr, Minnehaha, Edgerton, Reaney, Payne, Sims and Greenbrier to Maryland street. D.

St. Louis, Mo.

ST. LOUIS, May 10.—At the last meeting of the city council of East St. Louis, a franchise was granted the East St. Louis Electric Railway & Power company to construct and operate an electric road. The line will commence at the levee on Broadway, passing up that street to Collinsville avenue, up Collinsville avenue to St. Clair avenue, and down that street to Cahokia creek. Cross lines will also be maintained on Illinois avenue, Tenth street and on Main street and Converse avenue. The fare to be charged will be uniformly 5c from and to any part of the city. The company agrees to pay $5,000 cash into the city treasury, and will have the lines completed and in running order within sixty-five days from the completion of the viaduct over the railroads on Broadway.

The committee on public improvements reported to the St. Louis municipal assembly favorably on the ratification of the time extension to the Municipal Electric Light company. R.

Boston, Mass.

BOSTON, May 10.—The committee on mercantile affairs of the Massachusetts legislature reported a bill to the senate on Monday of this week relating to the regulation and supervision of electric wires in cities. The bill provides that the wires used shall be suitable and strong, suitably and safely insulated at points of attachment and fastened to suitable supports; that all wires shall be thoroughly insulated at points of entrance to buildings and, if other than electric light wires, must be provided with a suitable automatic cut-out: and that all wires, except street railway wires,

shall be tagged at points of support with the name of the owner or user. The bill also provides for the appointment of an officer in each city of the state whose duty it shall be to supervise the electric wires, and who shall have power to direct the removal of such wires as are dead or do not conform to the requirements of the law. Provision is made for the enforcement of the law, and it is to take effect upon its passage. The appointed officer would have no control over electric wires placed underground. The bill has not yet been considered by the senate, and it is likely that if passed at all it will be in a very much amended form.

The bill providing for the consolidation of gas and electric companies, which passed the senate last week with practically no opposition, provoked a very animated discussion in the house of representatives, the rural legislators thinking they saw in the bill the possibility of "an electric light trust." The bill was sent back to the committee by a vote of 109 to 78.

The bill providing for the inspection of electric lights and meters by the state gas inspector was referred back to the committee, and a substitute with slight and unimportant changes has been presented by E. W. Burdett, the representative of the Massachusetts Electric Lighting association. Tests of electric lights and meters can only be made in cities and towns from which complaint is made by 20 consumers. All expenses for such tests are to be paid by the electric light companies of the state. The bill is not likely to encounter much opposition.

The committee on cities has reported "inexpedient" upon the petition to give the board of aldermen of Boston full control over the erection, maintenance and removal of all electric wires in the city. The general bill referred to above was thought to be sufficient. For the same reason Mayor Hart of Boston, was given "leave to withdraw" on the petition that authority be given to this city to regulate electric wires and the power they convey, and also on the petition for a transfer to the city of the authority now exercised by the board of gas and electric light commissioners over electric wires.

The bill to allow the increase of the capital stock of the Boston Electric Light company from one to three millions, passed to a third reading in the senate by a vote of 25 to 12. It was stated that the additional capital was needed because of the company's intention of expending $400,000 for additional equipment of the Atlantic avenue station, and $450,000 for a new station in Roxbury, and to make other needed extensions and improvements.

Quite a remarkable and unique form of contract has just been recommended by the aldermanic committee on fuel and street lights of Holyoke, Mass., as the best for the city to adopt for the future electric lighting of the city streets. In regard to the candle power of the arc lights the contract is thus specific: "The average light of all the lamps of each circuit considered by itself and independent of all the others, shall constantly, while in operation, equal that of not less than 800 standard sperm candles weighing one-sixth of a pound each, and burning, as near as possible, at the rate of 120 grains of spermaceti per hour; the measurement of the electric light shall be made by comparison, through the use of a Bunsen photometer, with a standard oil or other lamp of at least 20 candle power ascertained and determined by direct comparison with standard candles of the standard aforesaid; the measurement of the lights shall be made while they are in their regular positions in the street, and with the globes on, and the method of ascertaining the actual candle power shall be as follows: The light shall be measured in a direction making an angle of 45 degrees with and below the horizontal plane of the light; four observations shall be made, each succeeding observation to be from the side of the vertical axis of the lamp 90 degrees from that of the preceding observation, and the average of said observations shall be ascertained; successive observations shall be made until ten such averages are obtained, and the mean of such ten averages shall be taken in determining the candle power. The average candle power of any six lights on any circuit shall be taken to be the average power of all the lights of such circuit, and if on any two nights of any month the candle power shall be found to be below that called for hereby, the average candle power for the month for that circuit." Should the actual candle power be found to be less at any time than that called for, payment is to be made only for the actual candle power as ascertained, the amount to be paid to be based pro rata upon the amount which would be paid were the candle power equal to that called for. Another clause provides that "the number of lamps on any one circuit shall not exceed the number which the dynamo for such circuit is rated to run, and such dynamo shall not be connected to any other circuit," a clause which is intended, of course, to prevent the running of arc light dynamos in series.

The Electric Mutual Insurance company, of Boston, has been incorporated. Its officers are S. E. Barton, president; H. H. Fairbanks, treasurer, and these with F. A. Gilbert, B. F. Peach, Jr., T. C. Bates, Wm. Brophy and Everett W. Burdett, directors.

The general meeting of the American Institute of Electrical Engineers is to be held at the Massachusetts Institute of Technology in this city, Wednesday, May 21.

O. H. M.

Kansas City, Mo.

KANSAS CITY, May 10.—The Southwestern Electric Light & Water Power company has filed articles of incorporation. This company is to furnish electric light and power to Joplin and neighboring towns. The board of directors is as follows: E. L. Martin, A. E. Stillwell, M. C. Curtis, T. Fox, R. R. Cone, and W. D. Taylor.

A meeting of the stockholders of the Gate City Electric company will be held July 1, to consider the proposition of an increase of its capital stock from $10,000 to $30,000.

About a dozen propositions concerning new quarters for the Missouri & Kansas Telephone company have been reduced to writing, and submitted to the company. No action, however, has been taken. The executive committee of the company will meet Tuesday, May 22, and it was stated by an officer of the company that this matter would then come up for consideration. W. W. Smith, secretary of the company, stated that he did not think anything would be done as far as determination upon a site is concerned at the coming meeting.

The Thomson-Houston company, which has the contract for putting in the "L" company's new electric line from Riverview to the South side in Kansas City, Kan., has opened headquarters on Fifth street and Colorado avenue, and the work of construction will begin at once. A large amount of the necessary materials has arrived, and it is proposed to push the work of construction as rapidly as possible

E. R. Weeks, general manager of the Kansas City Electric Light company and ex-president of the National Electric Light association is agitating the question of having a city electrician or electrical inspector. "With a practical, capable electrician, honest, and with common sense," says Mr. Weeks, "we would not care how rigidly the law might be enforced." Wires from isolated plants are now strung across highways and through private property here at pleasure. These concerns are under no bonds to the city to indemnify in case of damage resulting from injury done by the wires, and, as some of the concerns are not responsible, the city might have to pay for damages done by a wire crossing a highway. The Kansas City Electric Light company is under bonds to the city to indemnify in case of damage, also properly to construct the appliances. P.

Pittsburg, Pa.

PITTSBURG, Pa., May 10.—The North Allegheny Electric Railway company of Allegheny City, Pa., has just been quietly organized, but the incorporators have already worked so effectively that there is not much doubt of its speedy completion. The directors are James W. Breen, J. J. Flannery, Hon. John O'Neil, Robert S. Frazier, Fred. Swicker and D. O. Barr.

The road will connect with the present Observatory Hill line at Barnes' tavern, and will from there run to the cemetery lane. When it is completed strangers visiting Pittsburg can get into a car at the postoffice and ride in the electric cars right into the heart of a busy petroleum producing center. This is something that cannot be said by any other large city in the United States.

A committee of councils in Wheeling, W. Va., is publicly charged with retarding the progress of electric lighting in that city. Some six months ago a plan was laid before councils for the establishment of a city electric light plant. Councils then appointed a committee to look the matter up, but so far they have failed to make any report, and it is now charged that the committee does not intend to make any report, either.

Kee Naa, a wealthy Chinaman, passed through this city the other day; and while speaking of the progress which is being made in his native country, he said: 'We have now railroads that are well equipped with the best of English and American rolling stock and all the latest safety appliances. There are several hundred miles of telegraph lines in the country, and we have electric lights in all the larger cities."

The directors of the Birmingham Traction company met a few days ago in the Hotel Duquesne in this city for the purpose of letting contracts for the electric road Thirty cars were ordered from the Gilbert Car company of Troy. The Standard Underground Cable company of this city obtained the contract for all the insulated wire required by the road. The question of the system of electric motors to be adopted it was decided to keep in abeyance for the present.

The Duquesne Traction company is now rapidly pushing the completion of its system. There are 200 men at work on the line, and the directors feel confident that they will have the cars running by the first of October.

An electric street railway is now projected between McKeesport and Reynoldsville and Dravesburg. These three towns form a triangle on the banks of the Monongahela about 12 miles from Pittsburg. In order to connect these places a bridge has to be built across the river, which of course will be done.

The directors of the Greensburg Electric street railway met a few days ago and let the contract for the building of the line, which is to be completed early in the fall.

The National Electric company of Wilkinsburg has applied for a charter. The concern is to be a limited corporation with a capital stock of $10,000. Its purpose is to manufacture electrical appliances.

The Elizabeth Electric Light, Heat & Power company was chartered in Harrisburg recently; capital, $10,000. The directors are: T. W. Martin, F. L. Bigham, P. T. B. Shaffer, J. J. Hill, G. W. Lutes and J. N. O'Neil of Elizabeth, Pa., and L. E. Meyers of Pittsburg.

The annual meeting of the Westinghouse Electric company was held on the morning of May 5, for the purpose of electing the members of the board of directors. The result of the election was: George Westinghouse, Jr., president; Henry M. Byllesby, Robert Pitcairn, John Caldwell, J. R. McGinley, Calvin Wells and Charles S. Pease.

The contracts have been signed for the construction of the Drexel Industrial Institute, an institution to be founded in Philadelphia for the industrial education of boys and girls by M. A. J. Drexel, the millionaire banker. The building is to cost $500,000, and the philanthropic donor has also created an endowment fund of $1,000,000 for the support of the school. The structure of course is going to be one of the finest in the Quaker City, and not the least of its magnificent details will be the electrical plant to be connected with the institution. This plant is to be installed with apparatus of the Westinghouse Electric company of a capacity of 1,700 incandescent lights. The dynamos will be located in the central part of the basement. They are to be inclosed with a railing only because they will be used for the instruction of the pupils.

The Westinghouse Electric & Manufacturing company held a similar meeting, and elected the following board: President, George Westinghouse, Jr.; directors, Henry M. Byllesby, Robert Pitcairn, C. H. Jackson, G. W. Hebard, J. R. McGinley, Calvin Wells, H. R. Garden and A. M. Byers. The directors of the Westinghouse Electric & Manufacturing company have called a special meeting of the stockholders for July 8, for the purpose of voting for or against an increase of the capital stock. On the same day the formal transfer of the business of the Westinghouse Electric company to the Westinghouse Electric & Manufacturing company, will be made. This increase of the capital stock of the company is made advisable by the fact of the company having decided to go into the manufacture of electric street railway appliances.

The East end district of Pittsburg will soon have an electric time system. The official in charge of the Western Union Telegraph office at the stock yards in the East end has about completed arrangements to give the correct time by wire from Washington, D. C. This concern will be known as the Western Union Standard Clock System.

E. H. H.

Austin, Tex.

AUSTIN, Tex., May 10.—Before leaving Austin, M. M. Shipe, of Abilene, Kan., who represents Kansas City capitalists, and who was granted the franchise for an electric street railway in this city, procured further concessions from the county giving him the right of way for ten miles outside the city including connections with the site of the proposed river dam, and right to transport freight as well as passengers. The enterprise will be known as the Austin & Travis County Rapid Transit company. He expects to file a charter from the state in the next ten days as soon as the company can organize and elect its officers. In two months it expects to commence laying tracks. He has gone north to arrange for material and supplies, and is negotiating with Captain Mather of the Austin Light & Water Power company for electric power. H.

Falls City, Neb.

FALLS CITY, Neb., May 10 —The members of our city council have visited several cities, and this week will advertise for bids for putting in the electric light plant here. All bids are to be accompanied with specifications in detail, though preliminary specifications are on file with the city clerk. The contractors are expected to put up a brick

building 16x30, as an addition to the present water pumping station, to be used as a power room; also, to furnish and put up in shape an eighty horse power boiler, to change the smoke stack on pumping station, to furnish complete a sixty horse power, high speed, automatic cut-off engine, a dynamo complete that will operate not less than 600 incandescent lights, alternating current; to supply 400 converters for standard sixteen candle power lamps, and give prices on 200 additional converters as needed; to furnish and put up the pole line with thirty foot poles, save at street intersections, where they call for poles five feet higher, and lamps of thirty-two standard candle power are to be put in at the street crossings. The pole line will be about three miles long; the work is to be done within ninety days from commencement. D.

THE ELECTRIC LIGHT.

Greenville, Tex , wants an electric light plant.

Barboursville, Ky., will have an incandescent plant soon.

The Tell City, Ala., Iron & Land company have decided to erect an electric light plant.

The Pennsylvania Railroad company has purchased a 90 light Westinghouse arc plant for use at Altoona, Pa.

The Bonham, Tex , Electric Light & Power company has increased its capital stock from $25,000 to $50,000.

The Indianapolis papers state that the Wood arc system will hereafter be manufactured at Fort Wayne instead of at Brooklyn.

The Montgomery, Ala., Citizens' Electric Light & Power company has been organized to furnish light and power. The Ball system will be installed.

The Elgin Light & Power company of Elgin, Ill., has been incorporated. capital stock, $100,000; incorporators, I. C. Towner, William Fay and B. Hayelow.

The North Highland Land, Improvement & Manufacturing company of Columbus, Ga., proposes to erect an electric light and power plant and make other improvements. S. A. Carter is president.

A six-story apartment house will be erected at Grand boulevard and Forty-first street, Chicago, at an expense of $150,000. An incandescent plant will be installed, and gas will only be used for culinary purposes.

Westinghouse alternating current apparatus for central station plants of a capacity of five hundred incandescent lights has been contracted for by a company which has been organized at Windsor Locks, Connecticut.

In the report of the finance committee of the common council of Rochester, N. Y., it is recommended that an appropriation of $142,000 be made for city lighting. The local electric light companies illuminate the streets of the city under contract.

The Ashley Wire company has purchased the plant of the Northwestern Tile company in the southwestern part of Joliet, Ill., and will begin the manufacture of nails. The company has with its purchase a water power of 150 horse power and will also run an electric lighting system and employ 250 men.

It will not be long before from the cliffs of the island of Vancouver will shine the electric light and shed its brilliant glare upon the shimmering surface of the Pacific ocean. An electric light company has been organized at Vancouver, B. C., for the purpose of lighting the city. The Westinghouse system will be used.

The Edison Illuminating company of Rochester, N. Y., has appointed the Rochester Trust & Safe company its agent and registrar of stock. The latter company will register all transfers of stocks and make payments of dividends. The Edison company recently increased its capital stock to $100,000, subscriptions for a portion of which will be received at the Trust company's office.

The Redondo hotel, Los Angeles, Cal., has been opened to the public and the *Evening Express* of that city pronounces the equipment thorough in every respect. It calls attention to the fact that hotel and grounds are brilliantly illuminated by arc and incandescent plants, and that a complete electrical service has been established. Rhodes & Keese, the local agents for the Thomson-Houston company, installed the plant, which is valued at $15,000.

The electric light is constantly growing in popularity in the city of Elmira, N. Y. The illuminating company of that place, which commenced operations less than a year ago, has since that time been obliged to twice increase its capacity owing to the great demand made upon the light. The Westinghouse Electric company, whose system of alternating current apparatus has been in use there from the first, received the third contract from the Elmira Illuminating company a few days ago, and the company has now a capacity of 2,250 lights.

THE ELECTRIC MOTOR.

The series electric railway for Rome, Italy, is now nearly completed, it is stated. The last ship load of material will be shipped this week. Three cars will be run on this line. A short telpher line of 100 yards is also to be erected at Rome.

A business man at Rochester, N. Y., is reported by a local paper as saying: "I never realized how valuable electricity was until the recent fire that partially destroyed the Wagner block. Our shop occupied a portion of the building and was fortunate enough to escape serious damage from the flames. But the engine that supplied power to the shop was buried under the walls of the south part of the building and, of course, we couldn't run our machinery. One of the firm suddenly remembered the electric motor, and in about four hours' time our machinery was moving along just as though nothing had happened."

The Tesla motor is to be introduced in the coal mines of the state of New York. The management of the Shawmut coal mines has just made a contract with the Westinghouse Electric company for seven of these alternate current motors and one thirty horse power generator. The apparatus is to be used in connection with the Hercules mining machine.

At a special meeting of the city council of San Antonio, Tex., last week, a franchise was granted a Denver syndicate, headed by Edward McCrillis, for constructing an electric street railway system in San Antonio. The system will center on Alamo Plaza, and diverge from there to all parts of the city. It parallels the present horse-car lines on many streets. The entire system is to be completed and in operation within the next nine months.

The Rochester, N. Y., Street Railway company has just closed a contract with the Ball Engine company of Erie, Pa., for three 300 horse power triple expansion engines, three 125-horse power Standard engines, and one 60-horse power Standard engine, making a power station of 1,335-horse power in all. The Ball engine company is also to furnish everything except the boilers, which will be of the Heine type. This electric power station is expected to be one of the most perfect stations ever built.

In an editorial on the recently opened electric road in Tacoma, Wash., the Sunday *Times* of that city says: "Where electric power can be used, it is preferable to any other form of motive power for street railways. The people of Tacoma have had an opportunity to foresee what the service will be in future. The route up the hill is satisfactory at present and accommodates a large number of residents and a far greater number than a cable on Ninth or Eleventh streets. The street railway company asks the city council to be released from that clause of their franchise requiring them to build 10,000 feet of cable on these streets and offer to build eight more miles of electric street railway and as well equip the Tacoma Avenue route with the electric service. This is a fair exchange. Let the city council grant the request."

The work of improvement made necessary by the prospective substitution of electricity for horse power in the street car system of Rochester, N. Y., has already begun. The work now under way consists in the completion and double-tracking of the line through Sophia and other streets to the driving park, by way of Saratoga and Backus avenues. It is expected that the work will be finished by the middle of summer. Eighteen car loads of heavy steel rails are now on their way to Rochester from Johnstown, Pa., and track laying for the improved system will probably be well under way the latter part of this week on the Lake avenue line, upon which the electric cars will first be run. These rails are much heavier and more durable than those now in use. They are grooved, but the opening is not large enough to admit a carriage wheel. The ties for the rails will be laid on from six to nine inches of broken stone, with a layer of macadam on top. The new tracks will thus be laid in the most durable manner, and it is thought that they will not need repairs for ten years. In addition it is thought that the heavy new cars will glide over the carefully prepared road-bed without jolting. It is expected that the first of the poles for the overhead work will be placed in position in about two weeks. It has taken considerable time to get the material together for the big improvement, but, once begun, the work will be rapidly pushed until the motor cars are running on the Lake avenue line. Ten cars are now building for this route, and, if no unforeseen accident occurs, they will be running about July 1st. A lot for the erection of a power house in the central portion of the city has been selected. As has already been stated, the Short system has been adopted, and every effort will be made by the company to have the motor cars ready at an early day. Ball engines have been purchased, and will soon be installed. The company has decided to use 500 volts, the standard accepted by other prominent companies at the suggestion of the National Electric Light association.

THE TELEGRAPH.

The city of Rochester, N. Y., has been increasing the efficiency of its fire alarm telegraph service under direction of Superintendent Charles R. Barnes. The city had outgrown the original system, and it was pointed out by the superintendent that it would require but an accident of a trifling nature to cripple the service so as to make it entirely useless. The executive board, acting under advice of Mr. Barnes, decided to improve the system and in June last the contract was let to the Utica Fire Alarm Telegraph company, state agents for the Gamewell company of New York. The work has just been completed. The old circuits were cut so as to comprise fourteen instead of eight and about twelve miles of additional wire were added. The cost of the improvements was $4,950 for inside instruments and $1,000 for additional wires. Many valuable devices of great interest to telegraph men have been introduced. One of them is thus described by the Rochester *Post Express:* "A large testing clock forms a part of the new system. It was built at the suggestion of Mr. Barnes, and it is the first of its kind used in this country. By means of it the circuits are tested every half hour without ringing the gongs in any of the engine houses. When anything happens to any of the wires, it is recorded on a dial on the clock, showing the time and the circuit on which the trouble occurred. Thus the clock gives a complete record of any troubles that may occur each twenty-four hours. Many times the changes of temperature would cause trouble on the wires during the night that would not have been known formerly at the central office, and this difficulty is obviated by the clock."

Miscellaneous Notes.

The State Phonograph company of Illinois has been incorporated at Chicago, to manufacture, lease and deal in phonographs, etc.; capital stock, $250,000; incorporators, E. L. Lohdell, G. Farwell and E. H. Pearson.

The government of Denmark has erected fifty telephone stations, chiefly on the west coast of Jutland, for the use of fishermen, who are thus able to communicate with fish dealers at a distance, and secure better prices. All the life-boat stations in the country are also connected by telegraph and telephone.

The telephone development in Austria during 1889 has been very considerable. Apart from the numerous small exchanges opened by the government in the smaller towns, the existing exchanges have developed rapidly. In Vienna the number of subscribers has increased to 3,000, and the demand is so large that the Vienna company are enlarging their central station to one of 5,000 subscribers capacity, and are raising a large amount of new capital to run the necessary cables. This exchange is beautifully fitted up with a multiple switch-board of the company's own design, made by M. Schaffler, of Vienna, and the service is rapid and good.

For some time cellulose has been used in the manufacture of paper, but its extended adoption has been retarded by its high price. Dr. Kellner, director of an Austrian cellulose factory, has, according to the *Elektrotechniches Echo*, succeeded in reducing the cost by the following process: The shredded wool is put into lead-lined boilers with a 5 per cent. solution of common salt, which is electrolyzed for three and a half hours. The nascent chlorine bleaches the wool fiber to a snow-white silky substance. The operation is conducted at a temperature of 126 degrees to 128 degrees C. The process is expected to have an important effect on the trade, as the paper made from cellulose is of particularly fine texture.

Personal Mention.

P. C. Burns of the Findlay Glass & Carbon company of Findlay, O., was in Chicago last week.

P. L. Rose of the Rose Electric Supply company of St. Louis, visited Chicago on business last week.

Arthur L. Bosley of the Heisler Electric Light company, of St. Louis, spent several days in Chicago during the past week.

Business Mention.

The Chicago offices of the Daft Electric company, F. J. Baker, manager, have been removed to 456 Rookery building.

The National Conduit Manufacturing company of New York has removed its offices to the *Times* building, Room 17, No 41 Park Row.

The Lockwood Instrument company of Detroit has furnished fifty current indicators for the switch-board of the Municipal Electric Light & Power company of St. Louis.

The Sprague Electric Railway & Motor company, has temporarily discontinued its Philadelphia office, and all business will hereafter, until further notice be conducted directly from the New York office 16 & 18 Broad street.

The British & European Patent Agency is located at 252 Broadway, New York. European patents are obtained by the agency at low rates. F. W. Barker, registered English patent agent according to the act of parliament, is manager.

A. R. Hussey has opened an office at 211 Randolph street, Chicago, for general electrical work. Special apparatus for telephone, telegraph, fire and police signal work, annunciators, etc., will be designed and constructed at short notice.

The Gibson Gas Fixture works of Philadelphia are still doing business at the old stand, according to the announcement of the circulars to the trade. This corporation has become conspicuous in its fight against the "fixture trust," and apparently finds it not only a pleasant but a profitable source of amusement.

The Equitable Electric Railway Construction company, Philadelphia, A. H. Chadbourne, president, Wm. Hazelton 3d, secretary and treasurer, and W. A. Stadelman, chief engineer, will continue to transact their general construction business for railways and isolated plants, for both lighting and power purposes.

Chadbourne, Hazelton & Co. of Philadelphia, formerly general agents of the Sprague company of New York, for Pennsylvania, Maryland, Delaware and Southern New Jersey, have made arrangements with the Wenstrom Consolidated Dynamo & Motor company of Baltimore, as sole selling agents for the United States.

The Eclipse Wind Engine company, Beloit, Wis., has just received from the Detroit Electric Light & Power company a second order for a rope transmission equipment; among the items more than a dozen large grooved rope pulleys, each with the Eclipse friction clutch attachment. The company has recently nearly doubled the capacity of its foundry and machine shops, and installed much new machinery, and yet it is found necessary to run the works night and day to keep up with orders.

The Fidelity Carbon company of St. Louis held its annual meeting on Monday, May 5th. The following staff of officers was elected for the coming year: L. B. Stephenson, president; Harry Baum, vice-president; Wm. Baum, treasurer; S. G. Booker, secretary and manager. This company has recently greatly improved its facilities for the manufacture of carbons of all kinds, and is meeting with great success in the sale of its goods. It has taken a number of large orders for arc lighting carbons, and is having

a very heavy trade on all kinds and sizes of carbons, brushes, etc.

W. K. Molinard of the Baxter Electric Motor company of Baltimore, is in Chicago in the interest of the company. He states that the Baxter company is doing a lively business in selling motors throughout the country, and purposes to extend its business, if push, capital and a most excellent motor can do it.

Julius Andrae of 225 West Water street, Milwaukee, has just issued an illustrated catalogue and price list of electrical supplies, manufactured and sold by him. The catalogue comprises over 100 pages, and is complete in every respect. Mr. Andrae has been established 30 years in Milwaukee, and his goods have a deservedly high reputation.

English, Morse & Co., engineers of Kansas City, Mo. report recent sales of power plants as follows: Pittsburgh Kan. Gas company, one 125 horse power Ideal engine; Boonville Electric Light company of Boonville, Mo., one 80 horse power Ideal engine, with steel boiler and complete plant; Abernathy Furniture company, Kansas City, Mo., one 30 horse power Ideal engine, with boiler, dynamo, motor and complete plant; Girard Electric Light company, Girard, Kan., one 60 horse power steel boiler. The firm reports large orders for Lahman-Kirkwood rocking grate, leather link belting, Hill clutch pulleys and Worthington steam pumps.

The St. Louis Electrical Supply company, which was recently incorporated under the laws of the state of Missouri, have purchased the stock of the St. Louis Electrical company at 403 North Eighth street, St. Louis, and will continue the electrical supply business at that address. The officers of the new company are: W. L. Scott, president and treasurer; J. F. Porter, vice-president; C. W. Brinck, secretary. In a circular letter, which the new company is sending out, it states that it is its purpose to increase and extend the business as much as possible, and that it will endeavor to carry a full line of electrical supplies at all times. J. F. Porter, vice-president of the new company, is well and favorably remembered as the president and general manager of the Porter Construction company, and late of the Central Electric Construction company, which was absorbed by the Leonard & Izard company some six months ago. Mr. Porter's energy and ability as a manager, and his wide experience and acquaintance in the electrical business, will guarantee the success of the new corporation.

The Columbia Incandescent Lamp company of St. Louis was organized a little less than a year ago, and secured quarters at 513 Elm street, St. Louis. They started the manufacture of an incandescent lamp of superior quality, and the merit of their product was soon recognized to such an extent that their facilities were not equal to the volume of their business. They have recently moved from Elm street to a large three-story and basement factory, located at 1912 and 1914 Olive street. The building is admirably adapted to their purposes, each floor being well lighted and well ventilated. The boilers are placed in the building at the rear entirely separate from the main factory. The engine, a 50 horse power Westinghouse junior, is placed in the basement, where it runs the dynamos and furnishes power for other purposes throughout the building. Three dynamos are in position—one Edison and two Mayo, and the company are intending shortly to almost double this equipment on account of the remarkable increase in their business. The first floor is occupied by the general offices and store and packing rooms. The offices are very handsomely finished in oak with attractive appointments, and are well lighted. Both second floor and third floor are occupied by the glass blowers and air pumps and the several testing rooms. The Columbia company have met with great success in the introduction of their goods, and have at no time since the opening of their factory been able to keep up with the orders they have received. They are increasing their facilities now as rapidly as the necessary apparatus can be made and set up, and will soon be in a position to take care of a very large share of the incandescent lamp business in this part of the country. The business is in charge of J. H. Roethamel, who is the president and managing partner of the business. The company has recently opened an office in Chicago, managed by C. H. Fizzell, formerly connected with the St. Louis office.

Electrical Patents.

Issued May 6, 1890.

427,032. Regulator or Rheostat. Force Bain, Chicago, Ill.

427,039. Method of Introducing Compositions into Electric Conductors. David Brooks, Jr., Philadelphia, Pa.

427,042. Electrical Train Signal. George D. Burton, New Ipswich, N. H.

427,062. Ceiling Fuse Block. Erick E. Erickson, Boston, Mass.

427,070. Electric Dental Plugger. William E. Gibbs, New York, N. Y.

427,087. Multiple Switch-Board for Telephone Exchanges. Milo G. Kellogg, Chicago, Ill.

The last claim follows:

"13. In a telephone exchange system, the combination of telephone lines divided into two classes, multiple switch boards for said lines divided into two sections, a switch for each line of one class on each board of one section and on a board of the other section, and a switch for each line of the other class on each board of said other section and on a board of the first-mentioned section, switch-connecting apparatus, whereby an operator at any board may connect together any two lines which have their switches at her board, and switch-testiog apparatus whereby she may test any line which is connected to all the boards of her section, and determine whether it is switched for use."

427,120. Test Circuit for Multiple Switch-Boards. Chas. E. Scribner, Chicago, Ill.

A feature of the invention is a circuit breaker, one circuit breaker being included in each line between the contact point on the spring-jack of the last board and the test piece or frame of said spring-jack. These circuit breakers are driven constantly in any suitable manner, so that as long as no plug is inserted in any spring jack of a line the circuit of said line will be continuously interrupted. On inserting a plug in a spring-jack of any line the portion of the line containing the circuit breaker will be left dead open at the spring-jack in which the plug is inserted, and thus the circuit breaker will have no effect upon the line.

427,121. Multiple Switch-Board Testing Apparatus. Charles E. Scribner, Chicago, Ill.

The invention consists in placing a buzzer in circuit with the individual annunciator in each line in combination with circuits and testing apparatus, by means of which, when a test is made, the buzzer will cause a tone in the telephone if the line tested is free. In case the line tested is already in use the circuit through the telephone test battery and buzzer will be found open, and hence the buzzer will not be set in vibration, and no tone will be heard in the telephone.

427,122. Magneto-Electric Machine. Charles E. Scribner, Chicago, Ill.

427,123. Electric Loop Switch. Charles E. Scribner, Chicago, Ill.

The invention relates to the construction of the loop switches, and its object is to bring the loop keys within the smallest space possible.

427,138. Electric Connector for Brake-Hose. William F. Wamsley and Thomas McIntosh, Walla Walla, Wash.

427,151. Method of and Apparatus for Making Rolled Forgings by Electricity. George D. Burton, Boston, Mass.

The invention consists in passing a bar or rod of the material to be forged by successive steps between forging dies, subjecting the bar or rod to the softening action of a current of electricity at such times as it is free from the dies, and withholding the current when said rod is in contact with the dies.

Claim fourteen is appended:

"The combination of two forging dies, a bar feeder for feeding a bar to said dies, and adjustable electrodes for passing a heating current through said bar."

427,154. Divided Multiple Switch-Board. John J. Carty, New York, N. Y.

The invention consists in a metallic circuit telephone line, including at the central office one coil of a converter, a branch from the center of this coil through the individual annunciator at one division, and a circuit through the other coil of the converter, including switching apparatus, and extending to the other division of the exchange and including the other individual annunciator of the line, with means at the subscriber's station for sending current from ground over the two limbs of the metallic circuit connected as a single circuit to operate one annunciator or for sending current over the metallic circuit line through the coil of the converter included therein to induce current in the other coil of the converter, which other coil is included in the circuit containing the annunciator of the second division.

427,155. Multiple Switch-Board Apparatus. John J. Carty, New York, N. Y.

Briefly stated, the invention consists in connecting the telephone lines in pairs with the different switches on the switch-board, a single series of spring-jack switches serving for two lines, one line being connected with the spring of each of its series on the different switch-boards, and the other line of the pair being connected with the frame of the switches of the same series.

427,156. Telephone Exchange Apparatus. John J. Carty, New York, N. Y.

The object of the invention is to provide means whereby the different subscribers may connect themselves, one at a time, with the listening operator, the invention being especially adapted for use in connection with metallic circuit systems when used in multiple switch-board systems, or in systems employing single switch-boards.

427,163. Regulator for Dynamos. William H. Elkins, Cambridge, Mass.

427,164. Regulator for Dynamos. William H. Elkins, Cambridge, Mass.

427,194. Calling Apparatus for Metallic Circuit Telephone Exchange Systems. Charles E. Scribner, Chicago, Ill.

By the use of this apparatus the switching device is modified so that only one break is made in the united circuit of the two lines when the generator is connected to signal over either one of the two lines, the generator being connected upon one side or the other of this break, accordingly, as one or the other of the two connected subscribers is to be signaled.

427,195. Arc-Lamp Attachment. Albert P. Seymour, Syracuse, N. Y.

427,204. Telephone. John C. H. Stut, San Francisco, Cal.

The last claim is given:

"5. In a telephone, the closed case having a diaphragm set in one side or connected therewith, and the contact points contained within the case, in combination with air or a denser gas under pressure contained within said case, and acting upon one side of the diaphragm."

427,208. Apparatus for Testing Electric Lines. Benjamin E. Waters, Brockton, Mass.

427,221. Electric Conductor Support and Protector. Eben M. Boynton, West Newbury, Mass.

427,225. Carburetor. James J. Cooper, Philadelphia, Pa.

427,235. Commutator for Electric Motors. Arnold A. Ingraham, New York, N. Y.

427,237. Automatic Electric Switch. Mary A. Kissell, executrix, Chicago, Ill.

The second claim reads:

"The combination of magnets joined in separate electrical circuits, each including a source of electricity and circuit-closing device, armatures for said magnets connected to each other, and one of them having connections whereby its movements may be utilized, and a cut-out comprising spring contacts forming terminals of said circuits, and an arm adapted to be moved from one of said contacts to the other by the armature movement, whereby one circuit is broken at the close of said movement, and a break in the other circuit is closed."

427,259. Electrical Collecting Device. George Forbes, Westminster, County of Middlesex, England.

Claim one is:

"A contact maker or brush for establishing electrical connection with parts in rapid relative motion—such as the collectors of dynamo machines—consisting of a plate of carbon."

427,294. Dynamo Electric Machine. De Witt B. Brace, Lincoln, Neb.

427,296. Insulator. Joseph F. Buzby, Royer's Ford, Pa.

427,333. Trolley. Willard F. Lewis, Swampscott, Mass.

427,341. Electric Locking Attachment. Hermann J. Meyers, Brooklyn, N. Y.

427,361. Power Transmitter for Railway Signals. Joseph Ramsey, Jr., Cincinnati, O.

427,387. Railway Signaling Apparatus. Henry D. Winton, Wellesley Hills, Mass.

427,405. Iron Core for Dynamo Electric Machines. Marcel Deprez, Paris, France.

The second claim follows:

"In a dynamo electric machine, an iron ring-core composed of laminated hollow cellular segments."

427,429. Electric Signaling System and Apparatus for Railroads. Charles H. Koyl and Jacob W. Lattig, Easton, Pa.

427,430. Electric Signaling System and Apparatus for Railroads. Charles H. Koyl and Jacob W. Lattig, Easton, Pa.

427,445. Electrical Conduit. George Sprague, Albion, N. Y.

Claim two reads:

"The combination of the elastic filling provided with longitudinal cells or leads and lateral slits or slots communicating with these cells or leads, and a removable casing or pipe inclosing this elastic filling."

427,459. Device for Unloading, Recharging and Reloading Electric Car Batteries. Jacob C. Chamberlain, New York, N. Y.

Of the seventeen claims the first and sixteenth are given:

"1. In a device for unloading, recharging, and reloading electric car batteries, the combination, with a source of electricity and an electric circuit, of a rack having several horizontal and super-imposed charging benches and a distributing hoist or carrier.

"16. In a device for recharging electric batteries, the combination, with a lug that projects from the battery and is in electrical communication with the battery cells and with a rack or bench that receives and supports such battery, of a contact plate in the electric circuit supported by springs, and held by bolts upon such rack."

427,468. Electro-Galvanic Belt. Alonzo Dow, Wooster, Ohio.

427,480. Ocean Signal Station. Alvin F. Paine, South Wellfleet, Mass.

427,489. Alternating Current Electric Meter. George Westinghouse, Jr., Pittsburg, Pa.

427,503. Electric Motor. Louis Duncan, Baltimore, Md.

427,513. Electroplating Bath for Copper. William B. Hollingshead, Bronxville, N. Y.

427,514. Key Socket or Switch for Incandescent Electric Lamps. Arnold B. Holmes, Boston, and George F. Gale, Winthrop, Mass.

427,515. Electrical Transmission of Power. Rudolph M. Hunter, Philadelphia, Pa.

427,521. Electric Switch. Ocron S. Platt and John M. Orford, Bridgeport, Conn.

427,522. Electric Switch. Ocron S. Platt, Bridgeport, Conn.

427,523. Electric Switch. Ocron S. Platt, Bridgeport, Conn.

427,530. Electric Current Regulator. Ernest P. Warner, Chicago, Ill.

The invention consists of the combination, with a driven shaft provided with a propeller screw mounted thereon and inclosed in a vessel containing liquid, of a rotating device in frictional engagement with said shaft, said shaft having a longitudinal movement in its bearings, the longitudinal thrust thereof, and consequently the frictional engagement with the frictional rotating device, being determined by the rate of revolution of the propeller screw in the liquid.

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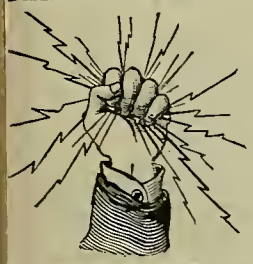

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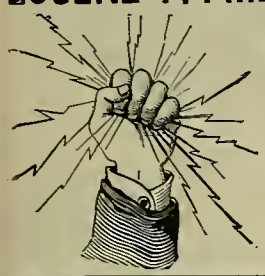

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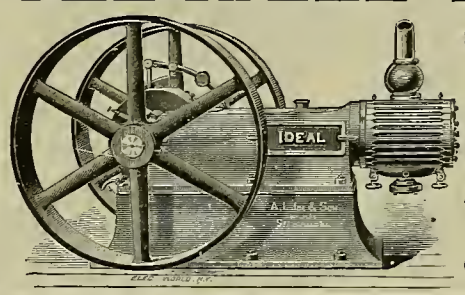

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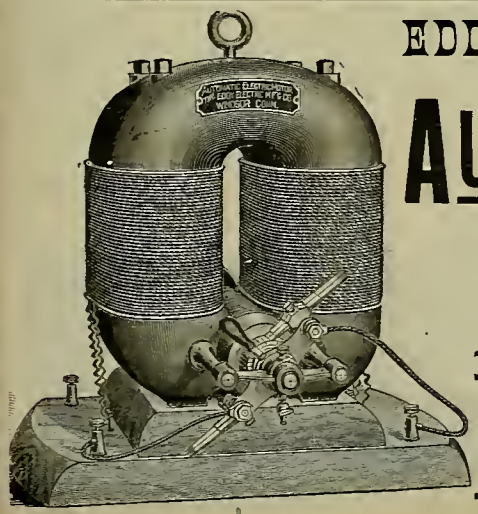

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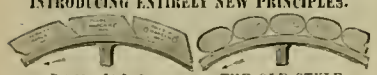

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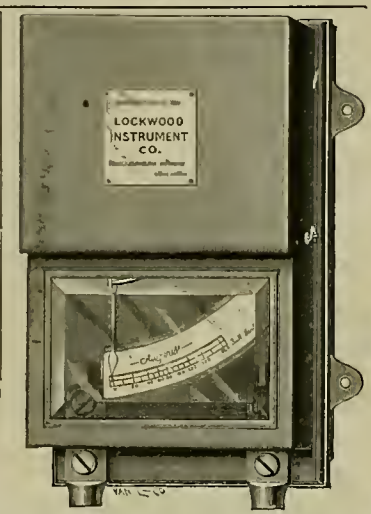

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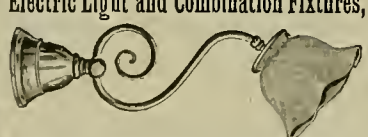

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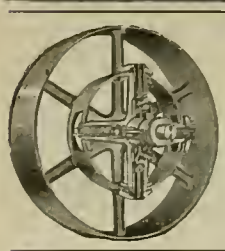

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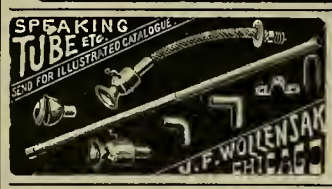

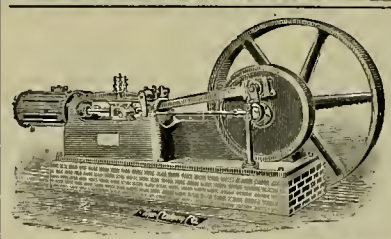

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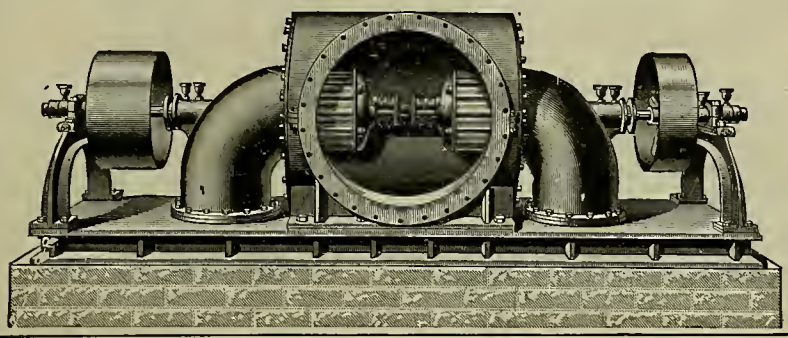

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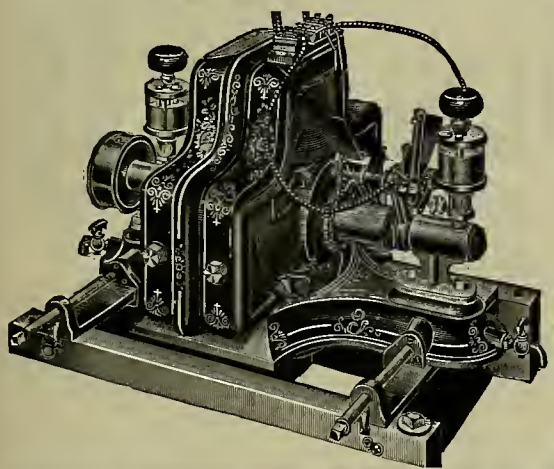

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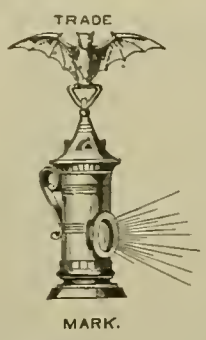

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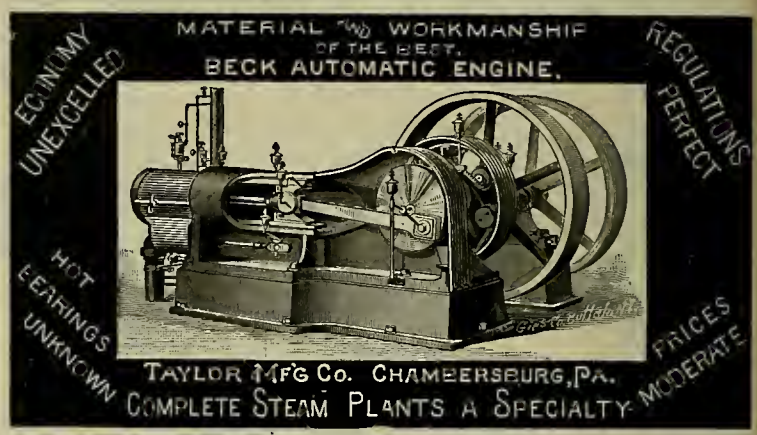

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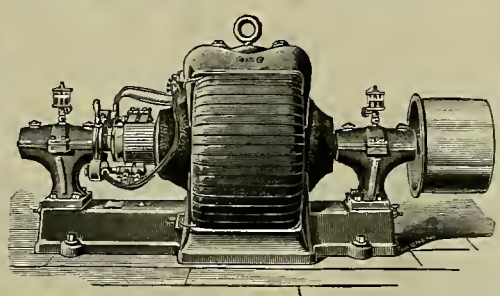

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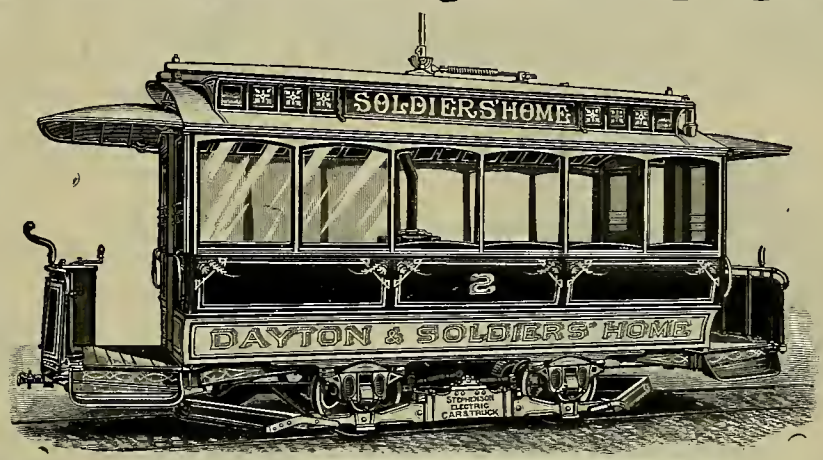

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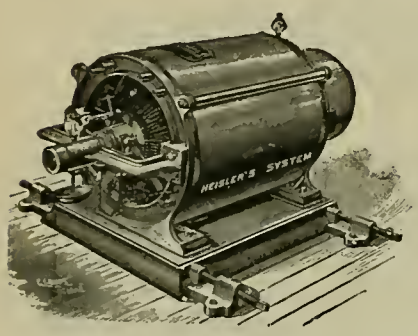

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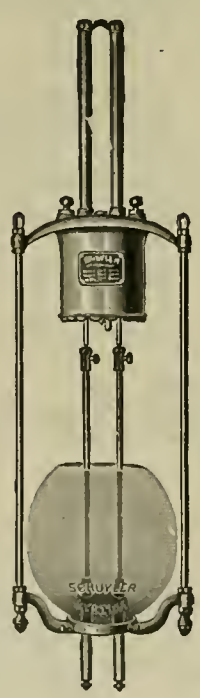

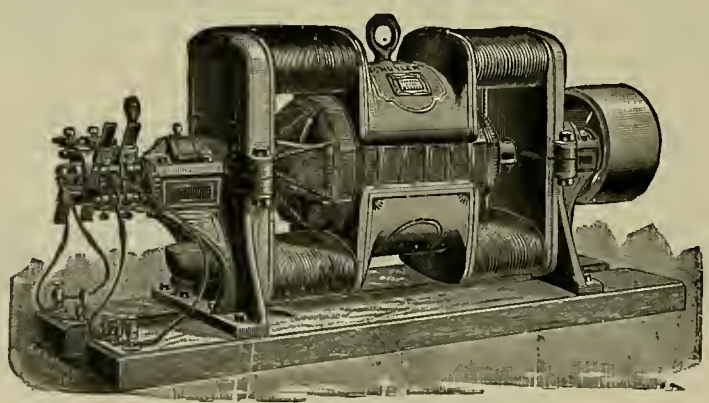

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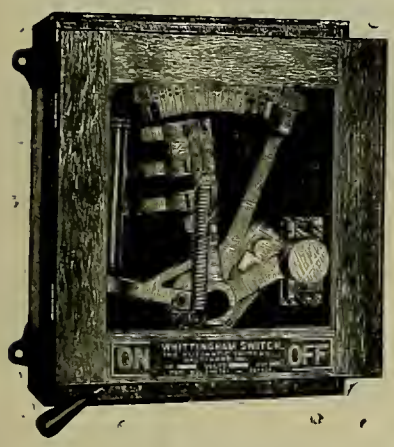

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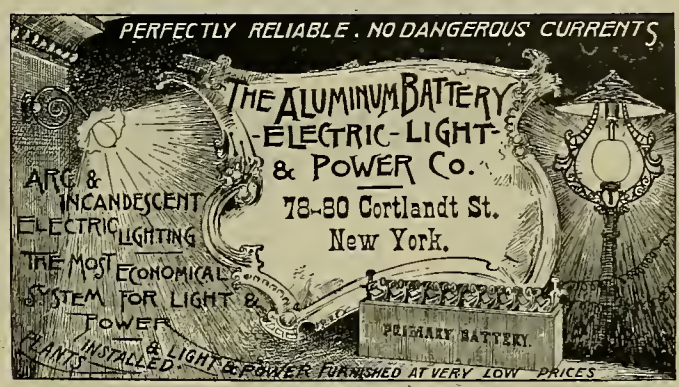

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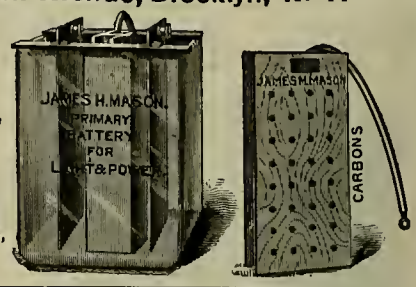

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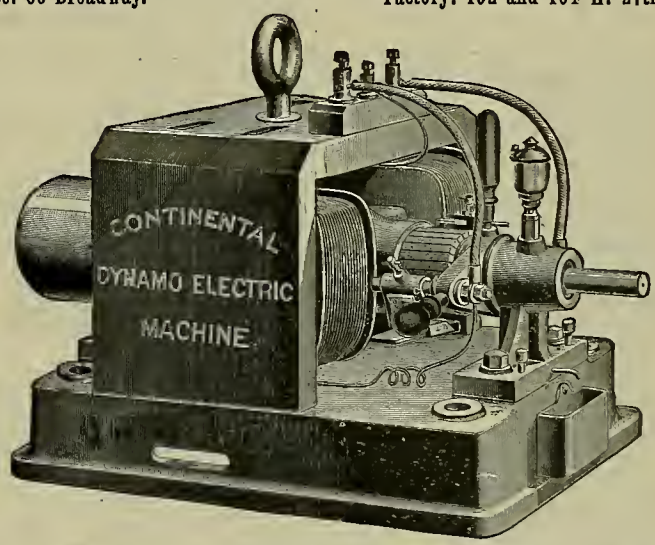

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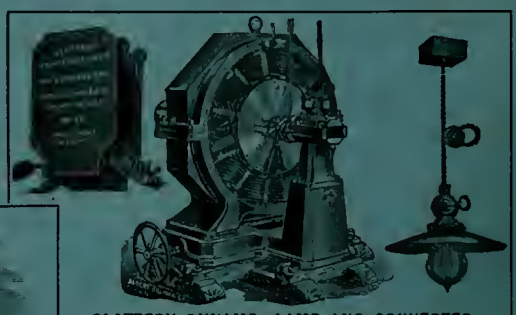

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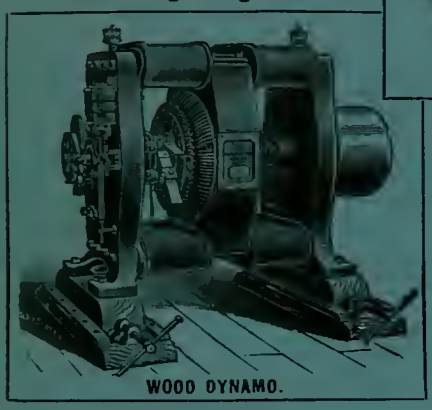

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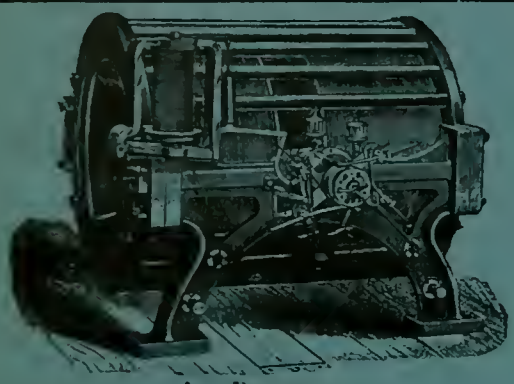

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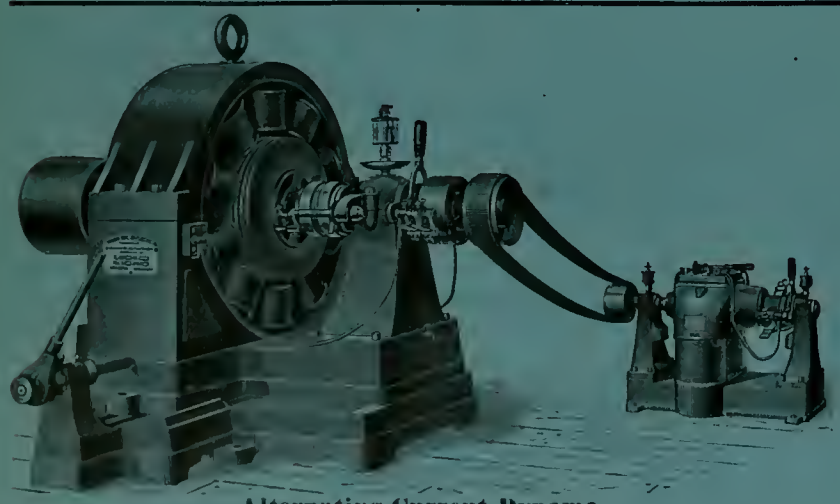

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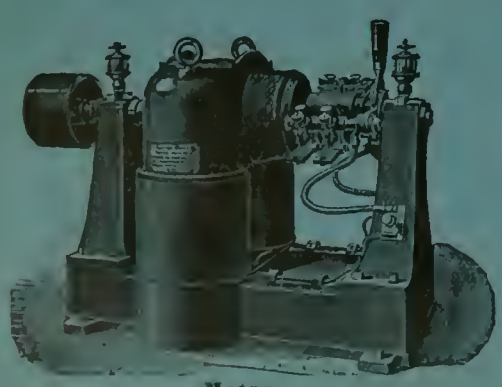

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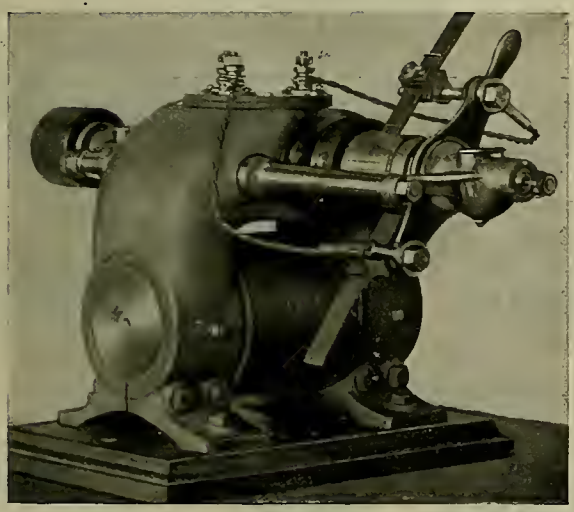

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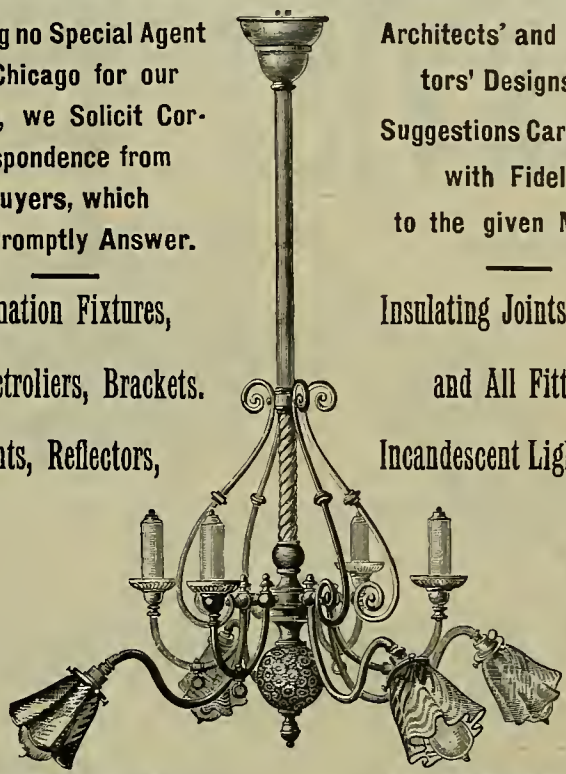

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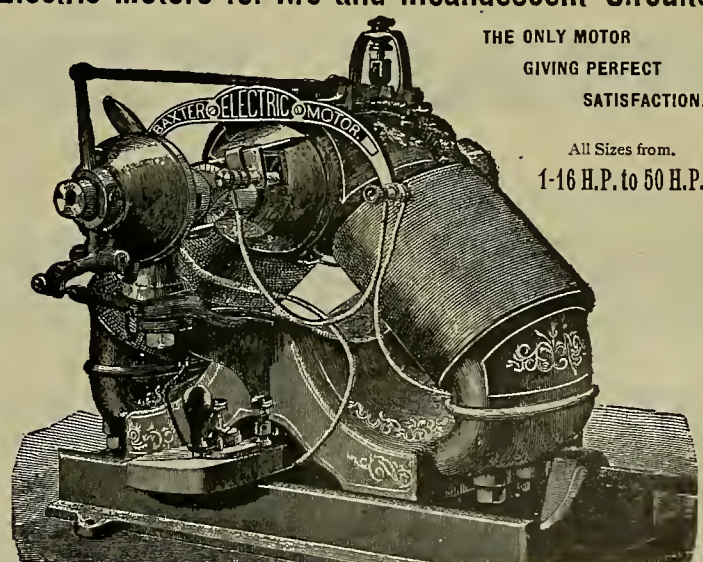

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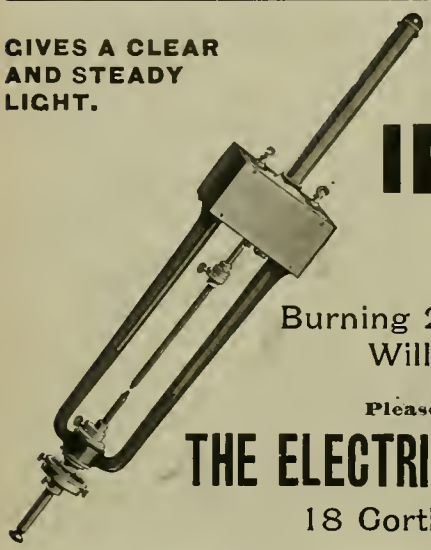

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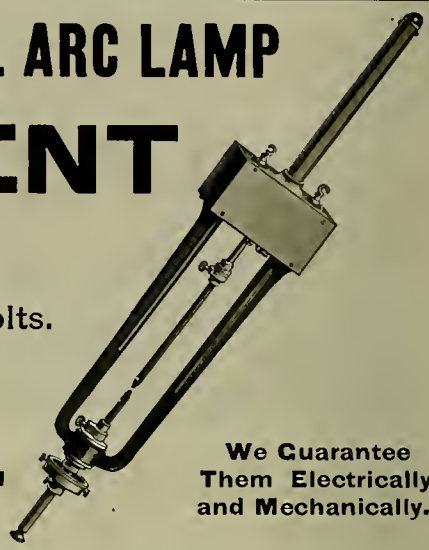

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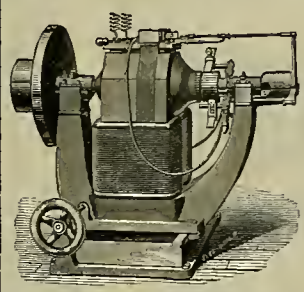

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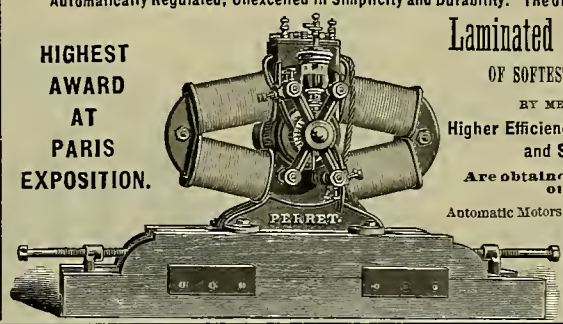

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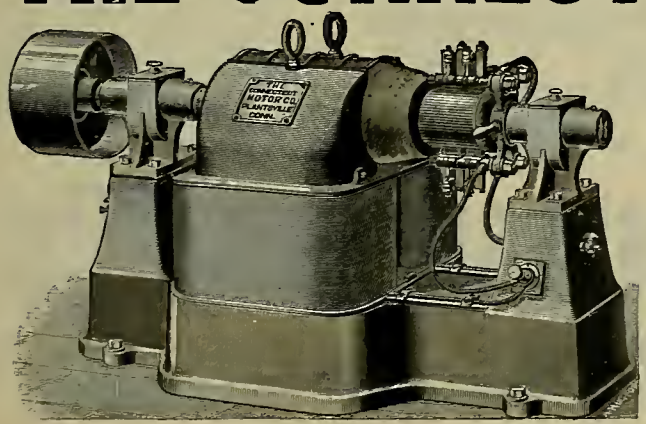

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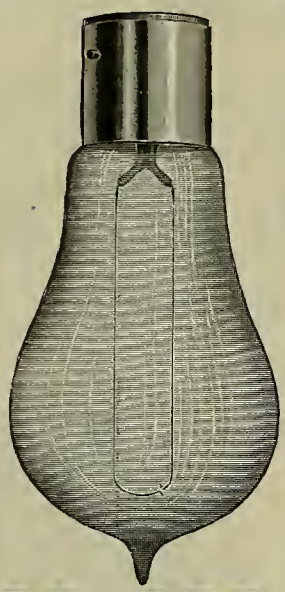

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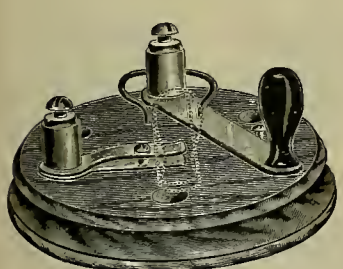
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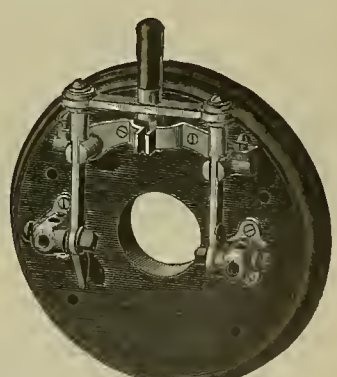
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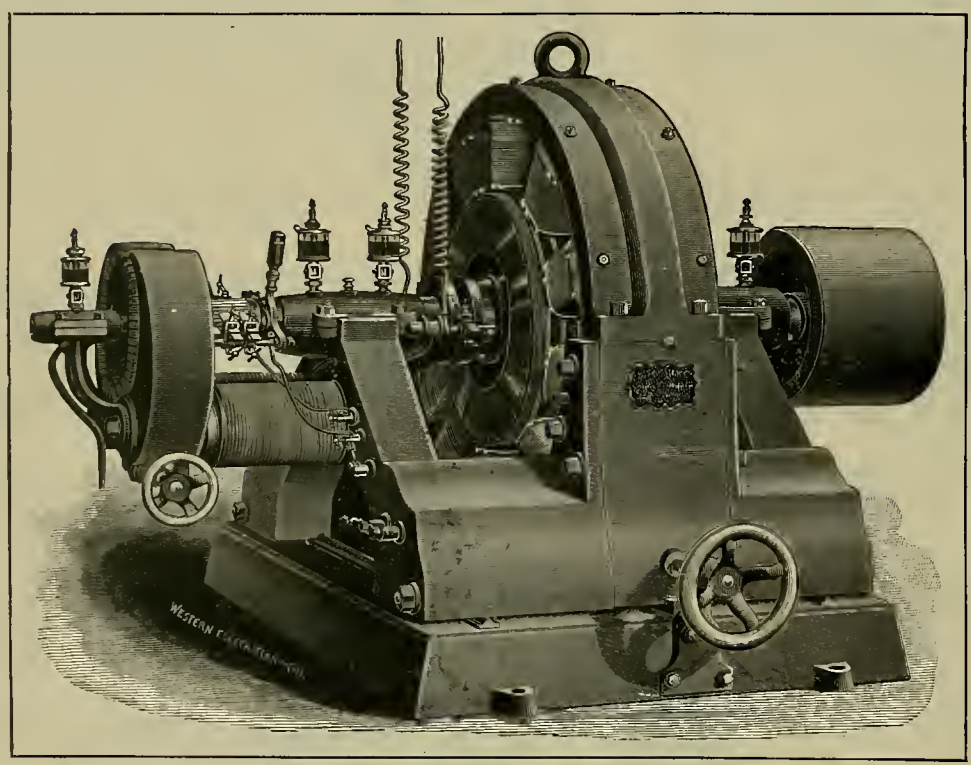

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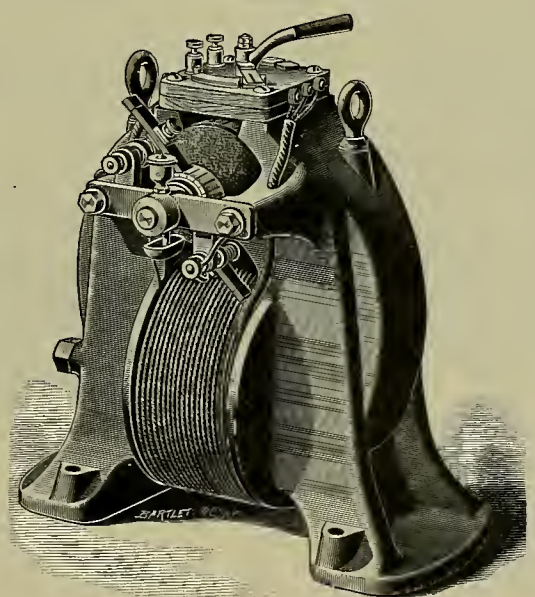

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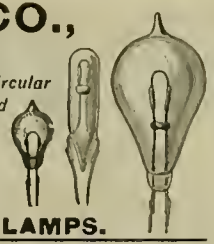

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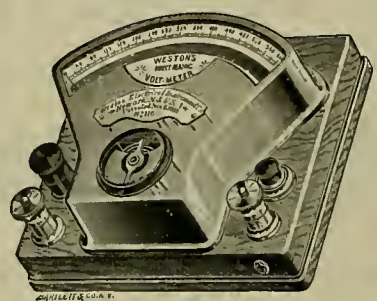

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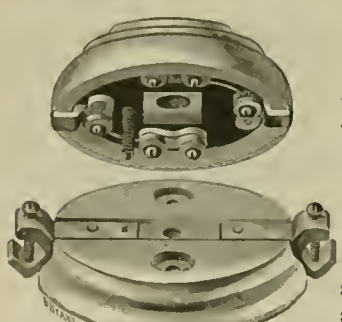

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Vol. VI. CHICAGO, MAY 24, 1890. No. 21

Electric Generators at the Chicago Office of the Postal Telegraph Company.

After an experience of two years at the New York office with current supplied from dynamos instead of batteries, the Postal Telegraph company recently decided to adopt this system in Pittsburg and Chicago. On May 1 a plant of generators was started in the latter city in the basement of the Phoenix building. The dynamos take the place of 9,000 cells which had been in service at this point.

Through the courtesy of J. E. Petit, chief operator and electrician of the western division of the Postal company, the WESTERN ELECTRICIAN is enabled to present a few of the more important details of the system.

ELECTRIC GENERATORS AT THE CHICAGO OFFICE OF THE POSTAL TELEGRAPH COMPANY.

The installation consists of 16 shunt wound generators of the United States motor type, and two 10-horse power 220 volt United States motors. These latter are of a type similar to the well-known United States dynamo. The generators are arranged, as shown in Fig. 1 and 2, in two sets one above the other. The motors are placed one at each end of the line of generators, and belt as indicated to a main shaft. The motors are fed from two separate and distinct leads from the Edison system. The shafting is provided with clutches so that either motor can run one or both sets of generators. The switch-board is so designed that almost any combination of currents can be furnished to the operating room, thus insuring practically, certain and necessary service.

Although there are 16 generators in all, one set of 8 machines is all that is required for the regular service. The other set of 8 machines is kept as a reserve.

The generators are especially wound for telegraph service. One dynamo in each set furnishes current to all the locals, loops, city wires and call-box circuits. The seven others of a set range from seventy to three hundred and fifty volts for main line circuits. In the quadruplex and duplex service all transmitters and sounders are wound to 20 ohms. The generator for this service gives a potential of 35 volts. Fig. 2 shows the manner in which the dynamos are arranged and the path of currents supplied to the main wires, and to the local instruments. The figures on the dynamos designate the voltage. The figures on the resistance coils designate the resistance in ohms. Each disc on the switch-board has an insulated plug on one side permanently inserted to prevent the possibility of short-circuiting the machines. The short city wires are supplied from the same generator as the locals. It may be mentioned that all the leads from the dynamos connect with the instruments and line, through resistance coils. These coils are proportioned for the service required on the lines, and are introduced as a precaution against damage from the sudden short-circuiting or grounding of a line. These resistances are figured at about 2 ohms to 1 volt.

In making the change from batteries to dynamos a number of interesting features were introduced into the system, among which may he mentioned a new style of loop-jack. By the use of this device in conjunction with the six-point switches which are placed in the office just above the loop-jacks, the "quad chief" is enabled to connect any two circuits in the office, whether quadruplex, duplex or single.

Referring to Fig. 3 which represents both sides of a quadruplex set, $S\,J$ represents the jack, which being closed, touches the rear metallic bar, M. Between bar M and the front bar F is a permanent resistance coil of 90 ohms. A plug P is faced with metal on one side only, so that its insertion into the jack cuts out the 90 ohm coils. Throwing switches B to the left, switches A to the right, and inserting the plugs P in jacks $S\,J$, changes the two sides into a repeater, and by inserting plugs of loop L (branch office) in the spring jacks $S\,J^1$, any branch office can be placed in circuit. The ease with which these changes are made makes the system of great convenience, where the distance to the branch office is great.

In the diagram T represents a transmitter; S, a sounder; $R\,S$, a repeating sounder; B^1 and B^2, termina bars; $P\,R$, a polarized relay; $N\,R$, neutral relay, $S\,J$ and $S\,J^1$, spring jacks; L, branch office loop.

The normal state of the switches is always to the right except in repeating, then one is thrown to the left. Very similar to that just described is the arangement for repeating from a single to a "quad" or duplex circuit. This will be readily seen by tracing the current in the diagram marked Fig. 4. In this $M\,R$ is a Morse relay; S,a sounder; T, transmitters; $P\,R$, polarized relay. In this case the "line spot" on the jack plugs is only large enough to connect with the rear bar M, thus keeping the 90 ohm resistance cut in.

The system as now installed in the Chicago

office is covered by the patents of F. W. Jones, assistant general manager and electrician of the Postal company.

The re-wiring of the switch-boards and coil-boards was superintended by J. F. Butterfield.

Electric Railways in Chicago.

Many attempts have been made to introduce electric street railways into Chicago, companies have been organized, franchises secured in some instances and right of way obtained, but heretofore some unknown agency has interfered, and prevented the accomplishment of the design. At last an effort will be made to construct an electric road, and it promises to prove more successful than the attempts formerly made. In this instance all the formalities have been complied with; the company has been incorporated as the Cicero & Proviso Railroad company, a franchise obtained from the town of Cicero before the territory was annexed to Chicago, the right of way obtained, and the contract awarded to the Sprague company.

The power house will be located at the intersection of Lake street and Harvey. It will contain a 250-horse power Corliss engine and two 110-horse power Edison generators. The work of construction is now under way.

The line of the new road will be virtually an extension of the Madison street cable system. It will extend from the end of the cable line out Madison street to Harlem avenue, thence to Lake street and back to the old city limits. Connection at this point will be made with Madison street. Both Madison and Lake streets will be double-tracked, while the cross lines on Harlem avenue and along the "old city limits," which are very short, will be a single track. The Johnston rail will be used.

Fifteen motor cars, each equipped with two 15-horse power motors of the Sprague type will be put on immediately, and additional cars will be purchased at an early day. The line will be eight miles in length. It is in one of the most desirable sections of the city. The residents of that part of town have been obliged to depend upon a "dummy" line heretofore operated by the Chicago, Harlem & Batavia Railroad company, and the lack of rapid transit, of course, impeded the progress of the locality. Now, however, real estate men look to a boom in that part of town. The line will be in operation in a couple of months. The Sprague company has been awarded the contract for the construction and equipment of the entire system.

Another enterprise is promised by capitalists interested in South Chicago and the Calumet districts. The Calumet Electric Street railway took out its papers of incorporation last week at Springfield, and it will have its tracks down before July 1. The incorporators are N. K. Fairbank, S. E. Gross, Joel D. Harvey, W. V. Jacobs and Otto S. Gaither. The capital stock is $50,000.

This is the plan of the road as given by Mr. Gross: "The road will start in at the rolling-mills in South Chicago and will run west on Ninety-third street through Calumet Heights—it used to be Stony Island—to Stony Island boulevard, then north on the boulevard to Ninety-first street and west on Ninety-first street to Dauphin Park, which will be the western terminus for the present. Later on we will branch out and lay our tracks north on Cottage Grove avenue to the terminus of the cable line at Grand Crossing, and also south to Pullman. A population of 30,000 will contribute to the road. It will connect South Chicago with Pullman and Dauphin Park, which will be a big advantage. We haven't chosen yet between the storage battery and the overhead wire, but I think we will conclude to use the Chicago storage battery system. We have been experimenting with that and find it practicable and less clumsy than the overhead wire system."

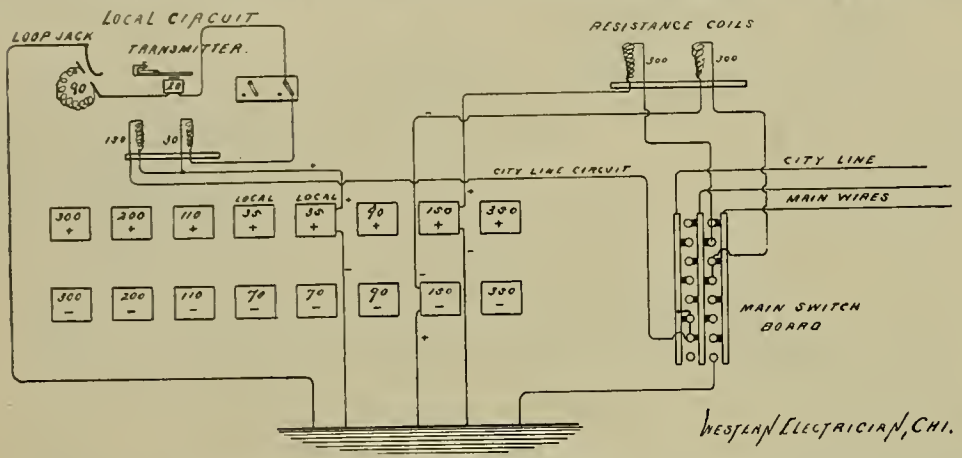


FIG. 2. ELECTRIC GENERATORS AT THE CHICAGO OFFICE OF THE POSTAL TELEGRAPH COMPANY.

The Tariff on Copper.

Congressman Butterworth of Ohio, in the House of Representatives last week, discussed some of the provisions in the McKinley tariff bill. His remarks on the copper question will interest electricians. He said:

But there is another to which I wish to call your attention, the copper industry. Why, sir, there has not been a time in two decades when my countrymen have not produced copper as cheap as any other nation in the world, and most of the time cheaper, and yet we have these people who on an investment equaling $1,250,000 have taken out over $60 000,000 in dividends in nineteen years, coming and asking additional protection. Will you tell why the duty on copper should be continued? Why not make copper free to all the people who are using it in this country?

Do you not know that every electrician in the country petitions to remove the duty on copper? Is it necessary to protect this industry? Is it an infant industry? Why, Mr. Chairman, it would be better if we had taken every man connected with that employment in the copper mines, boarded them at the Fifth Avenue hotel, and set them up in the banking business for life. There is no apology in the world for the duty. Not the slightest. It does not protect any industry, but it draws on every family we represent. There is not a yard of wire, not a piece of copper in any household in the land that does not pay tribute to these people.

That is not all. Although they have the American consumers at their mercy, there is not a nation on the earth the citizens of which do not buy American copper cheaper than the American citizens buy it. Nor is that all, Mr. Chairman, but having control of the copper market, in 1887 they organized a combine by which the supply of American copper had to go back to American homes sifted through the mercies of a French syndicate. I am in favor of protecting industries to the last and to the fullest measure necessary, but I happen to know that these gentlemen have simply placed all our people under tribute. It is not a question of protecting the industry. I remember that Gen. Garfield in a speech said, and my friend will remember this statement: The trouble is that when you insist that we shall not run to the extreme somebody claims that you are not sound on the tariff. That is the output of a very feeble mind. There are few men who have labored longer and harder in the interests of protection than I have.

What I am saying is in defense of the system, and is submitted in order that it may not come tumbling down about our heads as a result of our attempt to shut out all the world under a Chinese policy. That is all. I am not prepared to say that my honored friends have not vindicated the wisdom of the system in this bill, but so far as these items are concerned, I insist that they have not. I am aware of the general outflow of rhetoric in the matter of oppressed labor. Do you know that one-third of the men in the mines say that one-fourth of the men in the shops to-day are not American citizens, and that a large percentage of them do not owe allegiance to our flag? The time has come when we must concern ourselves about American homes and American firesides. Why, in some of the mines of Ohio, Pennsylvania and New York, and in many of the shops, they do not even go on the roster by their names. I mention this to my Republican friends, because the time is coming when the American boys and American girls will begin to ask whether question of duties in certain lines are in the interest of the so-called pauper labor of Europe or in the interest of the boys and girls born in our own country.

In Favor of the Electric Railway.

Judge Reilly of Detroit, has handed down a decision in the case of the Detroit City Railway company against certain residents of Mack street, a suit brought to restrain the defendants from interfering with the construction of an electric railway. The Detroit City Railway company secured the right to build an electric line on Mack street in 1889.

Work was commenced last year, and at about the first step which was taken to provide the necessary arrangements for electrical propulsion, the company found itself opposed by a small army of indignant householders. Poles were erected on each side of the street, and the householders of Mack street cut them down. The poles were erected again and cut down again. Shotguns and axes prevailed on the eastern thoroughfare for about two days, and then came a siege of injunctions. Finally, the whole question narrowed down to one lawsuit brought by the Detroit City Railway company against the Mack road residents, in which the court was prayed to restrain them forever from interfering with the electrical apparatus of this road. The

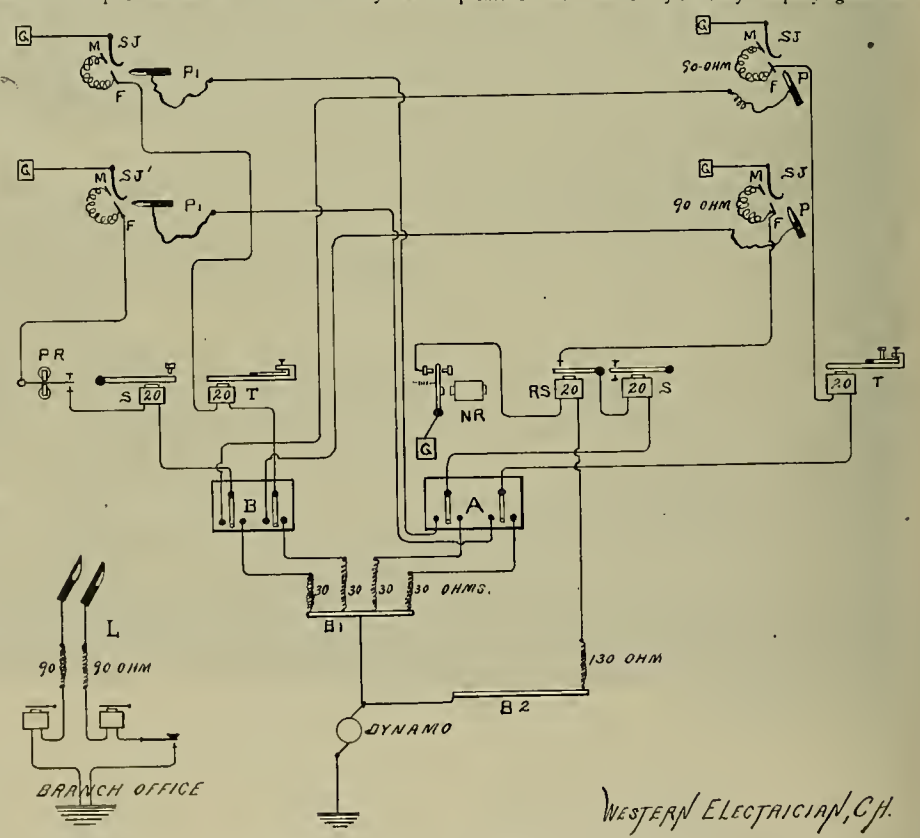


FIG. 3. ELECTRIC GENERATORS AT THE CHICAGO OFFICE OF THE POSTAL TELEGRAPH COMPANY.

residents were willing enough to keep their hands from the wires, but they thought that the court ought to compel the company to pay them damages for having their street filled up with unseemly poles, etc.

The defendants claimed that the act under which the Detroit City railway is organized was unconstitutional; that it had no right under its charter to use electricity, and

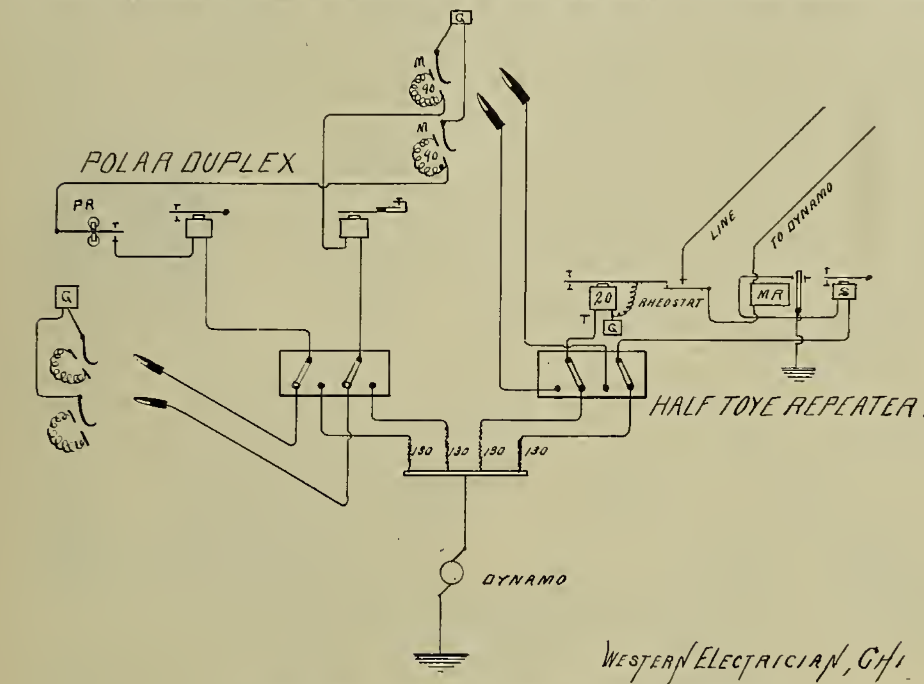


FIG. 4. ELECTRIC GENERATORS AT THE CHICAGO OFFICE OF THE POSTAL TELEGRAPH COMPANY.

that in doing so it trespassed upon private property. The case was submitted to a long trial some time ago, and Judge Reilly has given it much consideration before passing upon it.

In his opinion, Judge Reilly said that the principal question which he would consider was whether the common council had the right to grant electric franchises to street car companies without making compensation to property owners along the street on which the street car line is built.

"This particular question has never been before the Supreme Court," said Judge Reilly, "yet Judge Cooley holds it to be proper legislative authority to permit a street car track to be laid regardless of the consent of abutting property owners. So long as the occupation to be followed by the street car remains the same, the motive power cannot be questioned. If steam were used then the company would propose to change the occupation of the road.

"The street railway here is operated neither by horses nor steam, but by a new energy, not known or even contemplated at the time of the passage of the act under which the Detroit City railway is incorporated, and hence it is argued that the legislature must have intended the use of the only power then adapted for street car purposes. But I think that the law not only authorized the use of any known force but as well any that might be devised by the inventive genius of the world suitable for the purpose.

"Does electricity constitute a new servitude or burden upon the streets? Is it a radical departure from horse power, and does it injure property and discommode the public more than the old horse power did?

"The only substantial difference is in the motive power. Instead of horses we have a current of electricity communicated to the motor in the car from an overhead wire suspended over the track. The poles are slightly in the way of travel, being placed as hitching posts, lamp posts, electric light poles, shade trees and telegraph and telephone poles are, near the margin of the sidewalk, and when they are properly planted, so as not to interfere with the usual use of the adjacent premises, they cannot be said to impose a new burden upon the street.

"But it is urged that these cars, moving apparently without external force, frighten horses and render it unsafe to drive along the street in wagons or buggies. This is no doubt true. During the past week I have had an experience upon this very street. My horse became frightened, and I was very much relieved to find a cross street. But my horse became equally frightened at a pile of burning stumps. If these cars frighten horses, then burning stumps do also, and if one is restrained as a nuisance then the other should be. I have seen cable cars in Kansas City and San Francisco moving along with great rapidity through streets crowded with foot passengers, carriages, wagons and other vehicles without creating any excitement, but I have no doubt that when they were first introduced they created a serious panic among the horses, which continued until they were accustomed to the new carriages upon the streets. Even in our city to-day horses unfamiliar with the sight of bicycles, fire engines, bands, horse cars or large moving vans are frightened, and yet we cannot reserve our streets for the use of educated horses only.

"Upon the question of danger from the electric wires, the testimony offered by complainant was in effect that the current used by it is not powerful enough to cause serious damage to any one coming in contact with it, while the defendants offered testimony showing that men and horses have been injured, if not killed, by a current no stronger than the one used by complainant, but each case grew out of some accident. The same objection might be urged against the use of steam, natural gas, artificial gas, telephone wires and electric lighting wires.

"There is great danger in any intense force unless managed properly, as we know from the everyday experience of the world, as detailed in the daily press.

"From a full consideration of all the evidence submitted, I think the granting of this franchise was clearly within the discretion of the common council, and that the Detroit City Railway company is entitled to a perpetual injunction."

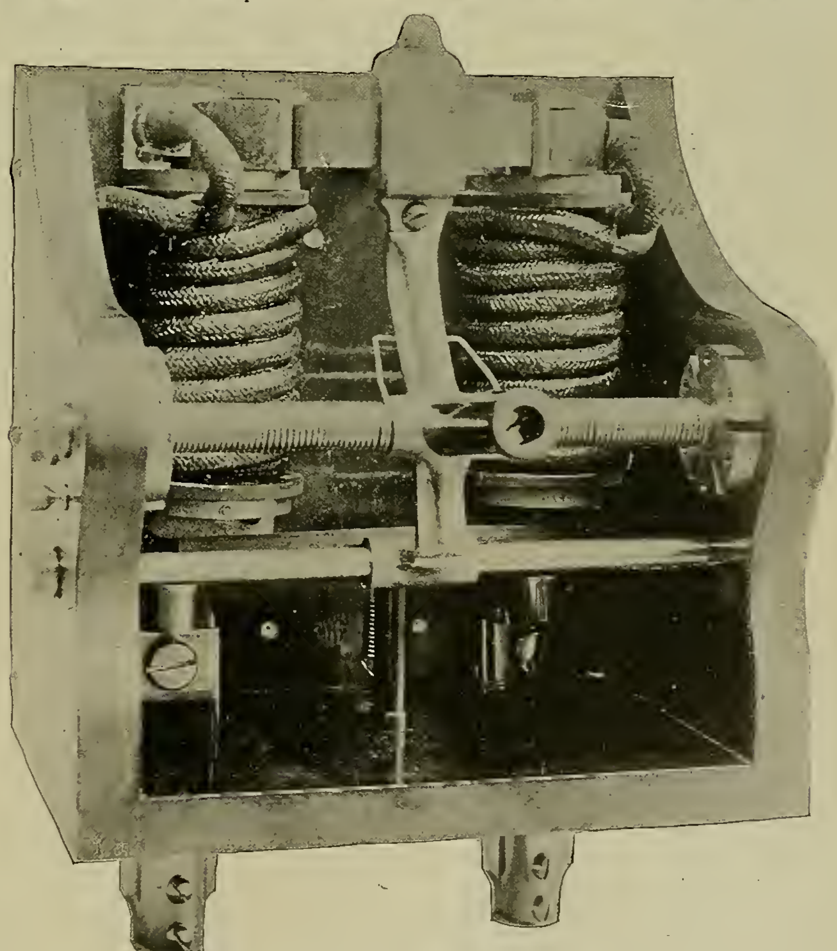
Proposed Municipal Control in Minneapolis.

The subject of municipal control of lighting is under discussion in Minneapolis. Alderman Potter favors the establishment of a city plant, and has introduced in the council a measure with this end in view. The question has been interesting the trade unions of the city. Representatives from the nationalists, trades and labor assembly and single tax league met last week to discuss the proposed municipal control of street lighting. Alderman Potter was present, and he explained the matter. At present, he said, the city pays $170,000 annually for street lighting of which about $75,000 goes for electric lighting at a cost of $150 a lamp per annum. His scheme is to utilize the east and west side pumping stations as generating stations, and to equip them at a cost of about $250,000. The annual cost of operating this plant would be, he estimates, about $40,000. He also submitted a large number of estimates, which have already been published. After some discussion the resolution was adopted asking those present to urge their respective organizations to work for the establishment of a municipal electric lighting plant in this city, to be owned and operated by the city.

A letter was read from W. J. Onahan, city comptroller of Chicago, in which he said that that city had 530 lights in operation at an annual cost of $66, or about 19 cents a night, and that the number of lights would soon be increased to 1,000.

Rae's Switch for Compounded Railway Generators.

In the accompanying cut is shown a compound switch designed by Frank B. Rae and manufactured by the Detroit Electrical Works, Detroit, Mich. The switch is used by the inventor in connection with the electric street railway system which bears his name. It is well known that when two or more compound dynamos are to be worked together in parallel, it is necessary in putting a machine into the live circuit to do it in a definite way. This may be done by two or more switches which close respectively, the ground circuit, the series winding and finally the armature circuit. Where a number of switches are used, however, unless the connections are made in a certain order a serious accident may



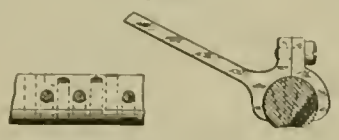
RAE SWITCH FOR COMPOUNDED RAILWAY GENERATORS.

result. To prevent, therefore, any accident which might occur through the carelessness of an attendant when coupling two or more machines together, Mr. Rae has designed the

switch so that one movement is all that is necessary to make in proper order the several connections. The advantage of this feature will be appreciated. The switch is substantially built and so designed as to insure clean rubbing contacts.

Improved Carbon Brush.

The accompanying cut explains itself. The brush was designed by Leo Daft, of Plainfield, N. J., to secure the beneficial results of the surface and conductivity of the carbon, together with a lubricating quality not heretofore united in one conductor. The carbon portion of the brush is made of compressed ground cemented



IMPROVED CARBON BRUSH.

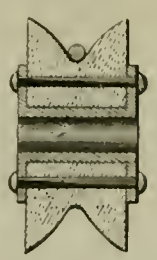
gas-retort carbon, or other form of non-lubricating carbon with pencils or pins of plumbago, inserted in the body as shown in the cut. Instead, however, of inserting the plumbago in pencils, powdered plumbago may be mixed with powdered carbon, in proportion, say from 5 to 50 per cent., using coal tar or molasses to hold the mass together during baking. The object of this combination is to form a conductor of a substance of high conductivity and great lubricating power, so as to reduce the wear of the commutator and increase the smoothness of its operation. Where it is desirable to secure a perfectly noiseless machine for light running purposes, it will be found beneficial to incorporate 1 or 2 per cent., by weight, of finely powdered silicate of magnesia in addition to the plumbago.

A Departure in Trolley Wheels.

The accompanying cut illustrates in section a new type of trolley wheel which has recently been invented by S. H. Short of Cleveland, O.

The object of the invention is to provide a wheel with a non-oxidizable surface, to run in contact with the wire, and also a trolley which in its action is practically noiseless. The results are accomplished, it is claimed, by making the body of the wheel of carbon. In forming the wheel a carbonaceous mixture of the kind known as "plastic" or "Bunsen" carbon, which is now universally used for the manufacture of pencils for electric arc lights, is used. The wheel is formed in suitable moulds under great pressure, so that the surface becomes very much more dense than the interior, and constitutes in effect a very hard skin, which envelopes the body of the wheel.

The inventor claims also that by the use of



A DEPARTURE IN TROLLEY WHEELS.

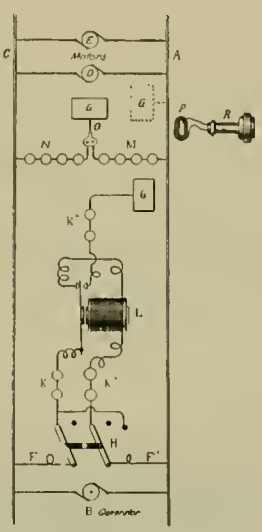
the carbon wheel sparking is prevented and the wear on the line conductor lessened to a considerable extent.

Apparatus for Locating Grounds on Electric Railways.

The accompanying diagram illustrates a method of determining and locating grounds on an electric railway by the aid of the telephone.

The invention consists in providing at the central station an artificial ground connection, including a resistance and a circuit interrupter, through which an irregular current is sent out to the grounded point, and thence returns to the artificial ground at the central station. A telephone with an indicating coil is passed along the line in proximity to the conductor, and the location of the ground detected by listening to the induction from the irregular current upon the line.

Referring to the diagram, the operation of the apparatus may be described as follows: The two groups of incandescent lights, *M* and *N*, are both normally connected to the ground by switch *O*. Suppose one of the main conductors, *A*, becomes temporarily grounded at *G*. This will immediately short-circuit the group of lamps, *M*, so that, while before there was little or no light given out by the lamps, their total resistance being too great for the potential of the line, after the ground, *G*, is established, the lamps, *N*, will come up to their normal brilliancy, and at once indicate that the conductor, *A*, is grounded. In a similar manner, if the conductor, *C*, becomes grounded, the lamps, *M*, will become bright and give an indication to the operator. The operator will then throw the switch, *H*, to one side or the other, according to the conductor which is grounded, the position which is shown in the drawing being that corresponding to a ground on conductor, *A*. There will then be a circuit from conductor, *C*, through lamps, *K*, through the armature of *L*, through the coil of *L*, through the lamps, *K*,, to conductor, *A*. This will cause the magnet to attract its armature until it comes in contact with the backstop, and the circuit will be from conductor, *C*, to lamps, *K*, to the armature, to



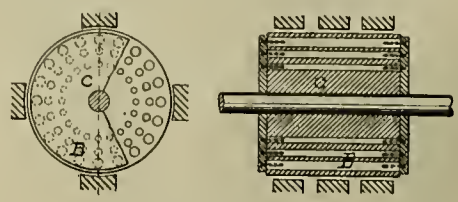
APPARATUS FOR LOCATING GROUNDS ON ELECTRIC RAILWAYS.

lamps, *K*,,, to the ground, thence to the fault on conductor *A*, and by the conductor *A*, back to the generator. The magnet *L*, being thus cut out, its armature will be released and the first circuit restored. There will thus be kept up a vibration of the armature, causing an interrupted current to be constantly sent along conductor, *A*, to the ground. As there are always four lamps in series in this circuit, corresponding to the normal potential of the line, there will be practically no spark at the contacts, as in no case will there be more current in this circuit than what is permitted by the resistance of the lamps. While the interrupted current is passing over conductor, *A*, the coil, *P*, is passed along the line, the operator listening in the telephone. He will constantly hear the induction until he reaches the point, *G*, where the ground is located. The sound in the telephone will then cease, and he will know that he has reached the fault.

The combination of apparatus for carrying out the above method was recently patented by C. H. Macloskie of Allegheny, Pa.

Alternating Current Motor.

According to the method of producing rotative motion by means of alternating currents proposed by Prof. Ferraris in Turin, two or more magnetizing coils placed at an angle to each other are so connected that on one hand they are traversed by alternating currents of different phases, and on the other hand, the resulting magnetic field of the coils travels in a determined direction of rotation. If in this rotating magnetic field is placed a cylinder of copper or iron, it will be caused to rotate by the reciprocal action of the magnetic field and the Foucault currents induced in the conducting body. An alternating current motor of this system having a copper cylinder will, however, not produce a high degree of useful effect, because the intensity of the magnetic field is but small. If an iron cylinder is employed, a strong magnetic field is obtained; but then the inconvenience arises that the electric currents are conducted much less than by copper, and therefore too great a resistance is presented to the currents. In order to obviate these disadvantages M. Von-Dolivo-Dobrowolsky, of Berlin, Germany, has designed a form of motor illustrated in the accompanying

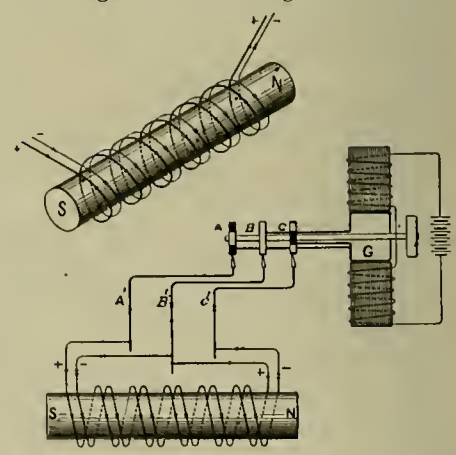


ALTERNATING CURRENT MOTOR.

cuts. In this machine the body in which the Foucault currents are induced, and which constitutes the armature of the motor, is constructed of iron and copper combination, the iron forming a solid or hollow cylinder *C*, while the copper is employed in the shape of bars *B*, or veins embedded into the surface of the iron and connected together at both ends by conductors of copper. These bars are arranged in such position as to be transverse to the direction of motion of the rotating part of the motor, and also transverse to the lines of force of the magnetic field. The copper does not require to be insulated from the iron, because the object of the improvement is only to present to the Foucault currents, in addition to the iron, a path which is more conductive than the latter, and thereby to increase the magnetic inertia of the armature.

Magnetizing Iron with the Alternating Current.

It is well known that if an alternating current be sent through the coils about an electro-magnet as ordinarily constructed, the magnetism of the core will be constantly reversed and no perceptible polarity will result. In order to overcome this effect and produce an electro-magnet by means of the alternating current, Lieut. F. J. Patten of New York has worked up the method which is illustrated in the cut. The constant current effect is brought about by winding the electro-magnet and connecting it to the source



MAGNETIZING IRON WITH THE ALTERNATING CURRENT.

of current as indicated. Referring to the diagram, *G* is an alternating current generator, provided with a contact ring, *B*, and two commutator rings, *A* and *C*. These latter are divided into a series of segments, while the ring, *B*, is plain or undivided.

The main leads, *A*', *B*', *C*', have the termini of the magnetizing helices connected to them. On the middle or central lead, *B*', flows a true alternating current; but the main, *A*', conveys all the + currents out, say from the alternating current generator, and they return along the lead, *B*', and are indicated by single arrows pointing along the helix + +, from circuit, *A*', to *B*'. The negative currents, indicated by double arrows and flowing, of course, in the reverse direction as concerns the leads, come out from the generator on the lead, *B*', and, passing through the helix designated — —, return on

C'. But, as shown by the single and double arrows, both these currents are caused to circulate around the bar, *N*, *S*, in the same direction. As these impulses, therefore, follow each other in succession without break or interruption, they maintain an unchanged polarity of the helices and inclosed iron bar, *N*, *S*.

Electrical Progress In Spokane Falls.

By A Traveling Correspondent.

An eastern visitor traveling through the west cannot fail to be impressed with the remarkable developments which are everywhere noticeable in the progress of electrical work in the young and enterprising cities. There is hardly a town to-day of 2,000 people on the entire line of the Northern Pacific railroad which has not its electrical plant or street railroad system, and some of these plants would do credit to an eastern town many times the size.

Perhaps the best illustration of this development is to be found in the young city of Spokane Falls, now a bustling town of 25,000 people, the supply center of Eastern Washington, Eastern Oregon and Idaho. This city is located on the banks of the Spokane river which is the discharge stream of the Coeur 'd Alene lake in Idaho. The river makes a series of cascades and falls within the city limits of some 124 feet in height, gathering itself together for one final plunge of 70 feet, and the power developed is used for operating the industries of the city, the electric light and street railroad plants, and in fact, everything requiring motive power. According to Col. J. T. Fanning, the hydraulic engineer of the Washington Water Power company of Spokane Falls, the power of the water at the lowest stage is equivalent to 30,000-horse power. In the spring of the year the flow of water often reaches 25,000 cubic feet per second, and by a system of head-gates at the mouth of the lake the flow could be so regulated as to give a steady power all the year round of 50,000-horse power.

The Edison Electric Illuminating company occupies the lighting field in the city, and its plant is the most extensive individual plant west of Denver, while the rates charged would make the average eastern customer of lighting companies green with envy. The Edison company started about three years ago, purchasing a small plant of 300 incandescent lights, and 15 arcs. In the great fire which visited Spokane Falls on August 4th, the station was fortunately saved from the conflagration, but the pole-lines in the business part of the city were destroyed. These pole-lines have since been duplicated in splendid form; and the writer saw in Spokane Falls some of the best outside construction that it has ever been his good fortune to inspect.

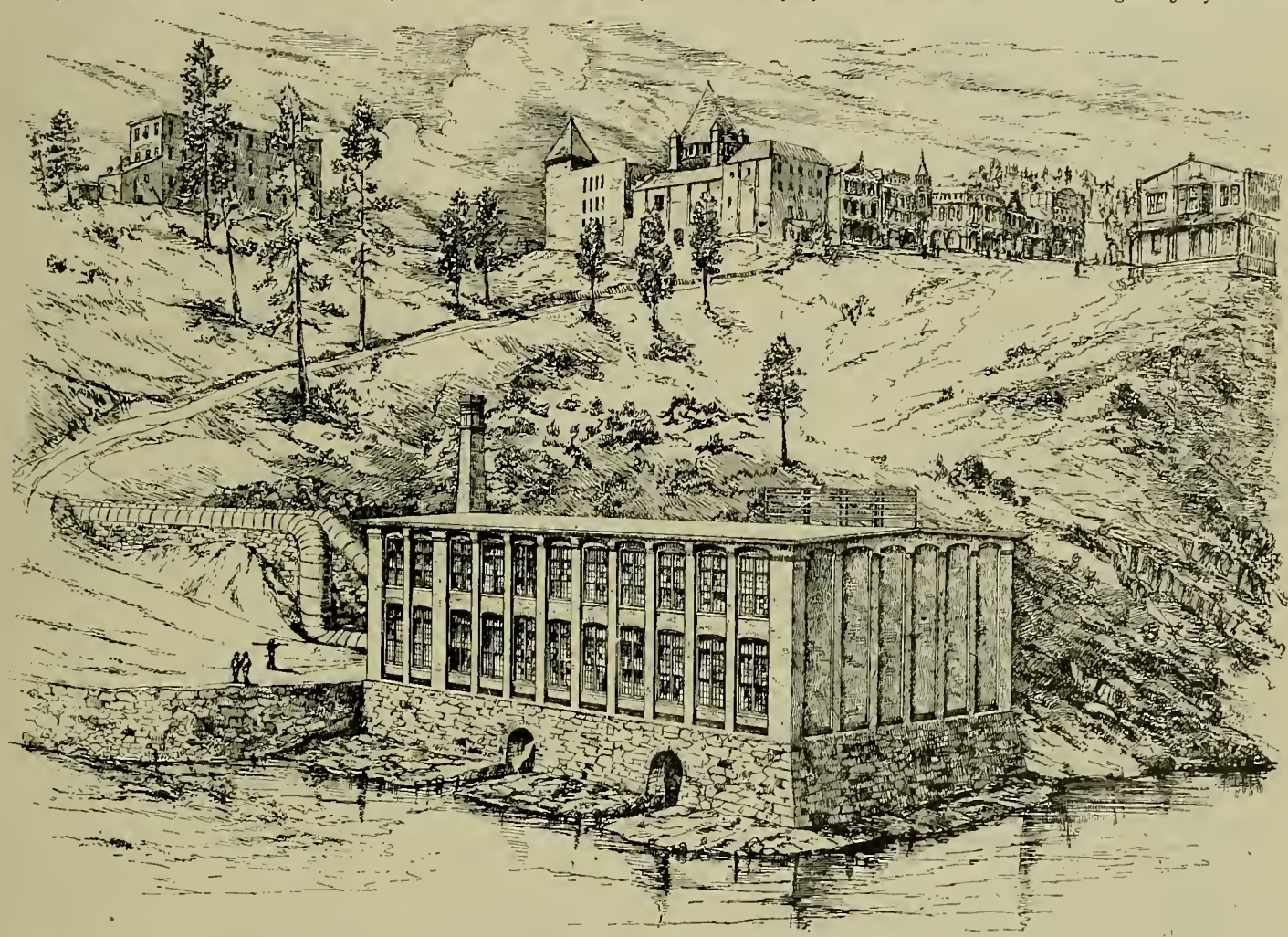
The overhead work on Front street, Main street and Riverside avenue on each of which the pole line is fully a mile in length, is of a model character. All the poles are 50 feet in height with 10 inch tops, as straight as arrows, well painted, bound with hoop iron and are stepped. At the time of the fire the plant of the company furnished 1,200 incandescent lights and 135 arcs, all run by water power in a single station. Immediately after the fire the demand for light was augmented greatly, two temporary stations were constructed, and the capacity of the plant was increased to 5,000 incandescent and 350 arcs.

The company uses the Thomson-Houston arc system and the Edison incandescent. Four Victor turbine wheels are operated in the temporary stations. Every printing house in the town is run by the current, and motors are used in most of the small manufactories and for the bulk of the elevator work. The forty motors now in use take about 125-horse power. The company uses the Sprague, Thomson-Houston, C & C and the Eddy motors, all of which give good results. The present stations of the company are of a temporary character entirely. The company is now building what is destined to be perhaps the best water power station in the United States; indeed, its arrangements are so novel and unique that the plans are given in the accompanying cuts and a somewhat extensive description of their chief features follows.

Some eighteen months ago the Washington Water Power company obtained possession of what is known as the main fall of the river. This power has a head of 70 feet, and is a confluence of various channels of the upper river. According to the engineer's estimate 15,000-horse power may be utilized. This site was selected by the engineers of the Edison company as the one place where absolutely reliable power could be had, where water could always be obtained without danger of interruption from the breaking of dams or the washing out of bridges, and where the station could be enlarged to suit the capacity of a town of 100,000 people. The plans of the station were prepared by Henry A. Herrick, C. E., the hydraulic engineer of the Washington Water Power company, under the superintendence of Col. J. T. Fanning of St. Paul, consulting engineer.

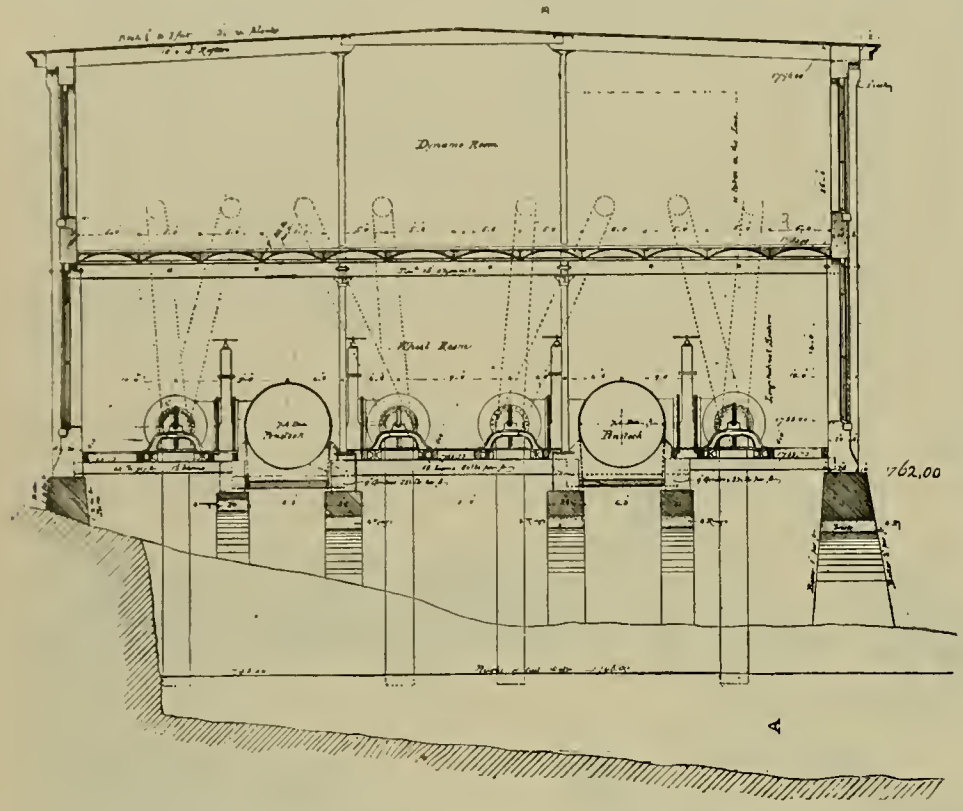
An examination of the views of the wheel rooms will show how carefully the details were worked out. The building is 65 by 120 feet, two and a half stories high. It is of fire-proof construction, the first of its kind on the Pacific coast. The dynamo floor is of girder iron with galvanized iron arches, filled in with concrete and artificial stone. The electrical gallery occupies one end of the building, the arc switchboard the other. The steam heating arrangements, work-shops, elevator, etc, are in an annex to the building. The wheel room and foundations are built in granite obtained from neighboring quarries and 2,500 perch of granite alone with 1,000 barrels of cement were used on the foundations. The contract for the iron work including the iron floors, girders, water wheels and flumes was let to the Stilwell & Bierce Manufacturing company, of Dayton, Ohio. The gross weight of the order of this one concern alone amounts to 600,000 lbs.

The water is conducted to the station in two immense parallel 5-16 inch steel pipes, 7 feet each in diameter, and is taken from granite gates at the dam, and carried 400 feet to the building. The two flumes are carried through the building parallel, and six sets of wheels are



ELECTRICAL PROGRESS IN SPOKANE FALLS—ELECTRIC LIGHT STATION.

fitted up on each flume. The wheels used are of twin horizontal pattern, 10-inch wheels being used in the incandescent plant, and 15-inch wheels in the arc plant. The 12 sets of wheels will give 2,700 horse power. The 8 sets now being equipped will give 1,500 horse power. The penstocks are equipped with gates on each wheel shaft, so that any one of the twelve wheels can be shut down without impairing the operation of the others. The contract calls for the delivery of eight of these wheels to begin with, and the foundations will be made for the full complement. In the incandescent department each pair of 10-inch wheels will drive a pair of No. 20 Edison dynamos or their equivalent of alternating machines. These wheels will make 1,000 revolutions per minute. In the arc department the wheels have a capacity of 375 horse power each, and will drive six arc dynamos of 50 lights each. The shaft on these wheels will be equipped with friction clutch pulleys, so that any one machine can be shut off or thrown on. They will make 675 revolutions per minute. Arrangements are made in the station for supplying street railroads with current. The electrical equipment of the station, when the first wheel is turned over, will be 8,000 incandescents and 500 arcs. The ultimate capacity of the plant is figured at 12,000 incandescents and 1,200 arcs. The building is located within 500 feet of the heaviest lighted center, and the city spreads out in all directions from the station.



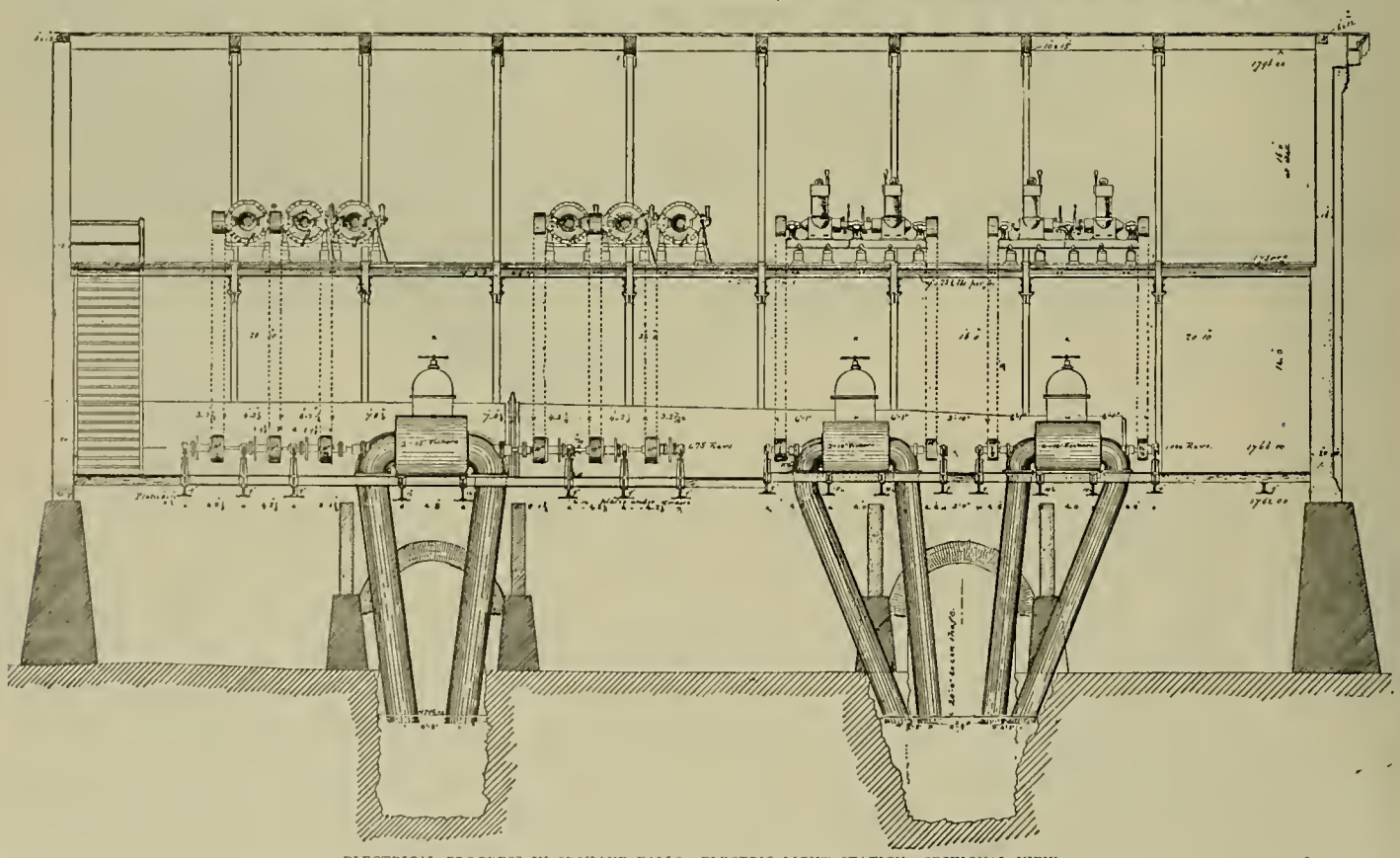
ELECTRICAL PROGRESS IN SPOKANE FALLS—ELECTRIC LIGHT STATION—SECTIONAL VIEW.

At present the company is lighting the majority of the residence and business houses of the town. The city is lighted under contract with the company with 100 Thomson-Houston arc lights. The largest consumer of the company is the Hotel Spokane, situated about 1,500 feet from the station, where about 800 16-candle power lamps are used.

The total cost of this new station will be in the neighborhood of $100,000. The company is able to state that it is running the only incandescent plant in the west day and night without interruption. The works have not been shut down for months past, even though a great deal of the new construction had to be made.

The capital stock of the company is $200,000, of which $150,000 has been paid up. The officers of the company are F. Rockwood Moore, president; J. W. Chapman, vice-president; J. D. Sherwood, treasurer; W. S. Norman, secretary and general manager, and J. B. Fisken, electrician. The designs for the hydraulic part of the station were prepared by Henry A. Herrick, C. E., and the electrical appointments by Mr. Fisken. But the Edison station is not the only plant of electrical interest in the city. Spokane Falls is the principal office of the Inland Telephone & Telegraph company, a new organization controlling the telephone in Eastern Washington and Eastern Oregon. The officers of the company are W. S. Norman, president; Jno. I. Sabin, vice-president; C. B. Hopkins, general manager; A. B. Irwin, superintendent, and Chas. Sidney Smith, secretary. The capital stock of the company is $300,000. The company is putting in a multiple switch-board in the city of Spokane Falls, where it has an excellent plant with 350 subscribers. It has several exchanges in the adjacent country, and almost every point in the territory is connected by territorial lines.

In the street railway department Spokane Falls has a splendidly equipped road owned by the Ross Park Street Railway company. G. B. Dennis is president of the company; H. N. Belt, general manager; Chas. Scribner, superintendent. The road is five miles in length, overhead Thomson-Houston system. It is operated by water power, and is now using six cars.



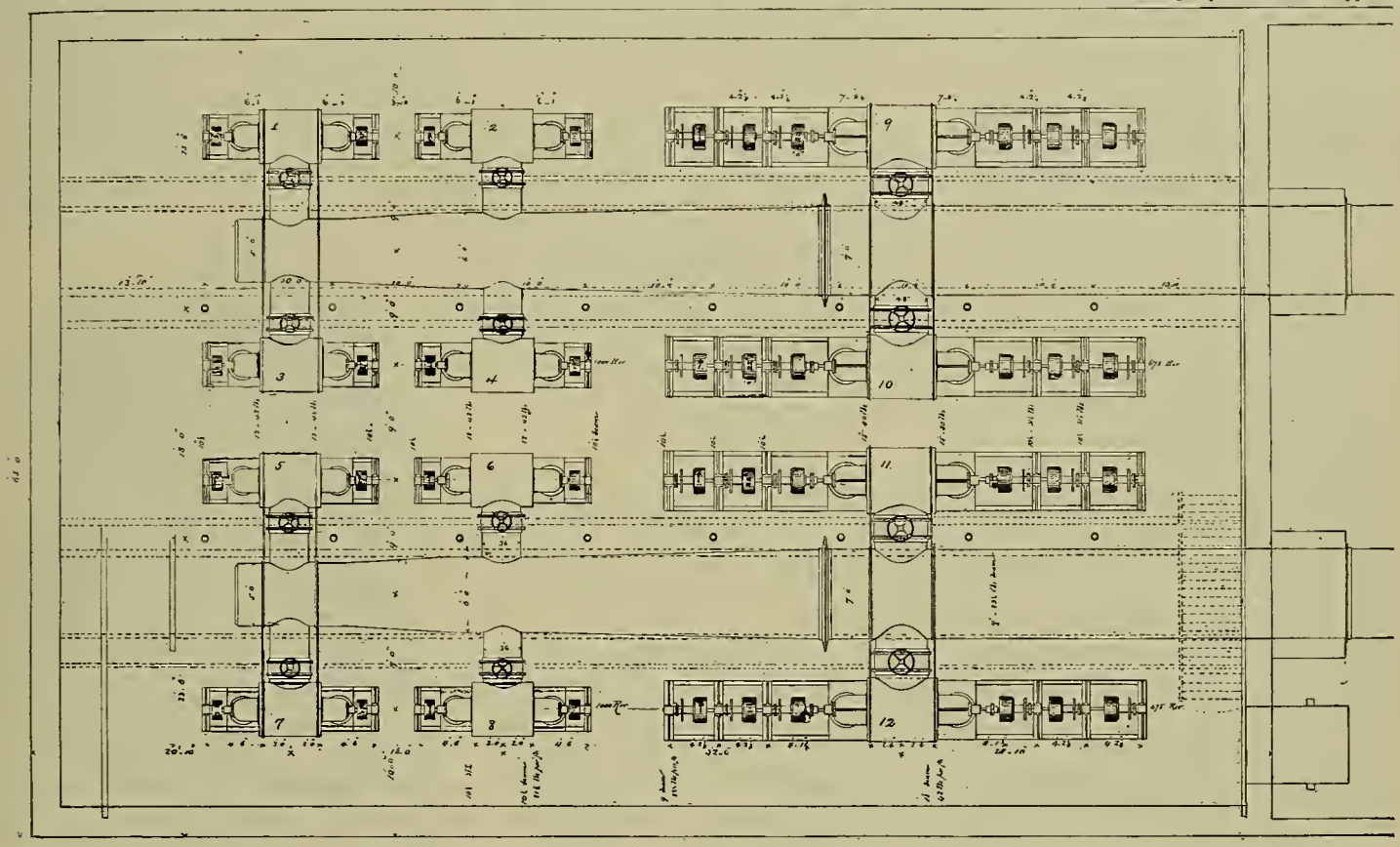
ELECTRICAL PROGRESS IN SPOKANE FALLS—ELECTRIC LIGHT STATION—SECTIONAL VIEW.

The Spokane Street Railroad company, which is now operating horse car lines throughout the business parts of the city, contemplates using the power of the river for generating electricity to take the place of horses and mules, and the Rapid Transit company is now equipping four

miles of road under the Thomson-Houston system.

The Spokane Falls Electrical society has just been organized, with W. S. Norman president. This society exists for the purpose of promoting the social, literary and scientific interests of its members. Prominence will be given to the discussion of scientific subjects, and one of its chief aims will be to spread the knowledge of electricity by means of lectures, etc. Its membership, which is now about thirty, is steadily on the increase, and there is every reason to suppose that this society, like others of the same kind in the east, will accomplish good work in the future.

The Hotel Spokane has just thrown open its doors—the first brick hotel completed since the fire. The hotel is lighted throughout by electricity supplied from the central station of the Edison company. The fixtures for the house were supplied, through the Edison company, by Bergmann & Co. The elevator is run by a



ELECTRICAL PROGRESS IN SPOKANE FALLS—ELECTRIC LIGHT STATION—SECTIONAL VIEW.

15 horse power Thomson-Houston motor. The rooms, 200 in number, were wired by the Telephone company, and a handsome Western Electric annunciator adorns the office walls.

The Electrolytic Extraction of Copper in Hungary.[1]

The 14th of April, 1890, will be remembered as an epoch in the history of copper mining in Hungary. On this day the first establishment for the production of electrolytic copper in the kingdom was opened, and in future the electro-technical industry in Hungary will draw its supply entirely, or in great part, from native sources. This event is the more significant, as mining in Hungary—a country very rich in metallic ores—has latterly, especially in Upper Hungary, been continuously declining.

This decay of the Upper Hungarian mining industry has its especial reasons. In consequence of the growing production of foreign mines and furnaces, a depression of prices was unavoidable, and only those undertakings could stand against the competition which had some advantage by reason of the character of the ores employed, of cheaper fuel, lower wages, or especially of the utmost possible simplification of the entire process, and which could consequently put their produce on the market at lower prices than others. In the last respect especially, the scientific progress abroad had placed us at a serious disadvantage. How complicated, tedious and costly is with us, *e. g.*, the extraction of copper, almost the most important of all metallic elements, and especially the refining of black copper. How well has it been understood abroad for years how this process may be simplified by taking advantage of the most recent advances of science, and enlisting electricity in the service of the miner and the metallurgist. Since the first application of electro-metallurgy at the Royal Smelting works at Ocker, the electrolytic extraction of metals has been successfully carried on in several foreign works.

At last Herr Alexander Soltz, the director of the smelting works in the Upper Hungarian Waldburgerschaft, turned his attention to the scanty communications which have appeared in journals and treatises on the electric extraction of fine copper, and entered upon the study of the new process with a view of introducing it into the "Stefan" works. This was more easily said than done. At Ocker, whither Soltz first went, an examination of the establishment was refused him, and the other concerns which had introduced the electrolytic process kept the details a complete secret. Thrown back thus upon his own resources, Soltz turned with the greater zeal to the study of this important question, and after spending some years in experimenting, he finally succeeded in solving the difficult problems of the composition of the electrolytes and the strength of current required. The president of the Upper Hungarian Waldburgerschaft, Arthur Prostner, took up the matter, and, with his experienced eye, recognized the scope of the new invention. For a man of his popularity and influence it was not difficult to gain over the board of directors of the Waldburgerschaft for the new process. Thus arose the installation for the electrolytic production of fine copper at the "Stefan" works. It has been in operation since March 12, but was only formally opened on April 14. This is the first installation in which fine copper is produced from argentiferous grey copper ore by the electric current, and silver is also separated. The process leaves nothing to be desired on the score of simplicity.

The electrolytic process for refining black copper is conducted essentially as follows: Plates of black copper are suspended in an acid bath of sulphate of copper (bluestone). Between every two such plates there is suspended a sheet of pure copper, and the current is passed from the black copper to the pure copper. Thereby sulphate of copper is decomposed in such a manner that the sulphuric acid is liberated on the plate of black copper (the anode), combines there with an equivalent quantity of copper and passes into solution, while the copper is deposited in the metallic state on the sheet of pure copper (the cathode). Admixtures of antimony, arsenic, lead and bismuth, as well as the gold and silver present in the black copper, remain as a mud at the bottom of the bath. The composition of the bath is not essentially affected by this process, though in time it becomes poorer in copper. Still, the bath used—as it has been proved by experiments at the "Stefan" works—can remain in use for years, though it must be from time to time restored to its original concentration by the addition of sulphate of copper or of a solution of granulated copper. The black copper is previously submitted to a purifying process in a reverberatory furnace, that it may be freed from iron which would contaminate the liquor. The liquor, which circulates in forty-nine baths, arranged like stairs in seven ranks, is pumped up by pumps of hard lead out of the two large tanks into the highest baths, and returns then to the tanks, after passing successively through all the baths. It is produced by dissolving granulated copper in hot dilute sulphuric acid, with access of air. The same apparatus is afterward used for regenerating the liquor.

All the machinery has been made in Hungary. The motor for driving the machines is formed of a Girard's partial turbine, supplied from the Krompach Heroader Iron works, of 32 nominal horse-power, of which at present only the half is in use. The same works have supplied the ingenious apparatus for transmission and the iron columns. The current for electrolysis is supplied by a continuous current dynamo, made by Ganz & Co. This machine is generally constructed for a strength of 60—70 amperes and 100—110 volts. In this case the wrapping has been so altered that the machine making 700 turns per minute gives a current of 240 amperes, and of twenty-four volts' tension. The strength of the current and the tension are shown automatically by an ammeter and a voltmeter. A hand rheostat serves to regulate the current. The current has to pass all the baths in succession, so that the same quantity of copper is dissolved and precipitated, amounting to about 328 kilos daily in full work. In each bath there are eight anodes and seven cathodes, all connected with the conductors. The copper sheets used as cathodes are made at the works by precipitating copper to the thickness of 2.3 mm. upon brightly polished sheets of copper, slightly oiled and insulated at the margin with a coating of asphalt or paraffin. In three months the plates of black copper are nearly consumed, and the cathodes have become plates weighing 70—80 kilos, not fibrous or lumpy, but remarkably clean and pure.

The silver mud at the bottom of the baths, which is about one-tenth of the weight of the black copper, is pumped up into a filter-press and further treated for the extraction of silver.

[1] Written by a correspondent of the London *Electrical Review*.

Rapid Transit in St. Paul and Minneapolis.

It was stated in the last issue of the WESTERN ELECTRICIAN that the residents of St. Paul believed that the street car company which controlled the franchises in that city and Minneapolis was pushing electric railway construction more rapidly in the latter city than within its own limits; that the company, in a word, was showing too much favor to Minneapolis. The business men of St. Paul met to consider the matter last week. After considerable discussion a committee was appointed "to ascertain," as a local paper puts it, why Mr. Lowry "has such a large crew of laborers in Minneapolis working upon the changing of the horse lines into electric and extending lines there, while in St. Paul he is dallying along with a little gang of only 150 men, and to warn him that the least failure upon his part in his contract with St. Paul will be the occasion for a citizens' demand that the utmost penalty be exacted from the street railway company."

It will be remembered that Mr. Lowry entered into a contract, the terms of which were embodied in an ordinance, whereby he was to have in operation by Nov. 1, 1890, something over 30 miles of new railway lines, to be operated by electricity or other power than horses.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE development of the New South is the theme treated by our Louisville correspondent this week.

IN the Boston letter is given a synopsis of Prof. Elihu Thomson's paper on "Problems of the Future." He predicts that among other things electricity will perform an important work in transforming crude materials into food.

THERE seems to be good reason to hope that Chicago will soon have two electric street railways. Companies composed of well-known business men have been organized, and in one case the contract for the construction and equipment of the road has been awarded. The particulars are given in another column.

AN article descriptive of the new electric lighting station at Spokane Falls, Wash., which is presented in this issue, will be read with interest by those contemplating the use of water power. As will be seen by the plans which accompany the article, the station is admirably arranged, and its details have been carefully worked out.

CARBON seems to be growing in favor as a material for contacts in heavy electrical work. The latest departure in this direction is a trolley wheel of carbon. In another column there is presented a description of the wheel. The inventor claims as advantages over the ordinary metal trolley wheel, a practically non-oxidizable contact surface and noiseless action.

THE decision of Judge Reilly in the street railway case at Detroit, which is presented elsewhere in this issue, will commend itself to electric railway companies generally. There is in the decision an evidence of hard common sense. The position of the electric railway company in regard to the questions of danger and injury to property are sustained by the court.

THE boom which Buffalo, N. Y., is now enjoying is due in no small degree to the advertising it has received through the proposed utilization of the water power of Niagara for manufacturing purposes. The project is assuming a tangible form. The *Express* of that city says editorially: "The result will be a marked improvement in the condition of all classes. The masses will be better fed, better clothed, better educated, and the poorest will have privileges and opportunities which under the old condition of things could not be obtained."

CONGRESSMAN BUTTERWORTH of Ohio made a few interesting remarks on the tariff question in the House of Representatives last week, and some of these referred to a subject of great interest to the electrical manufacturers of this country—the copper question. These remarks are quoted in another column, and will repay careful perusal. It is not expected, however, that the petitions and protests of the electrical fraternity will avail in the matter. It is feared the McKinley bill will pass, and electrical manufacturers will be obliged to pay the tax imposed by the government, that a foreign syndicate may control the copper market.

IN cities where the moonlight schedule is in force, there is always dissatisfaction experienced by the citizens on nights when the moon, according to the almanac, is shining, though unfortunately its rays are obscured by clouds. This trouble existed in Omaha, and the murmuring of the residents of the city became so pronounced that the city council committee on lights determined to find if possible, some remedy. In accordance with its suggestion, on nights when the schedule calls for the moon, but that luminary is hidden behind the clouds, the night captain of police has been authorized to order on the lights. The city will always, therefore, be lighted without needless expense, although the lights must be on as many hours as the schedule calls for.

THE formal opening of the new rooms of the Wisconsin Electric club at Milwaukee, last week, was an event of more than ordinary importance to the electrical interests of the state. The membership of the club includes many prominent business men, electrical experts in all departments; inventors and students, and it will therefore be readily understood that the organization is in excellent condition to engage in the work of promoting the electrical interests of the state. The club is formed after the style of the Chicago Electric club, and a prominent feature of its proceedings will be a series of papers or lectures on electrical matters. An extended account of the opening of the club rooms and the banquet will be found in another column, from which an idea of the purpose and character of the organization may be gained.

SEVERAL weeks ago there was presented in the columns of the WESTERN ELECTRICIAN a description of the current generating plant at the Chicago office of the Western Union Telegraph company. In this issue a similar plant, which has just been installed by the Postal Telegraph company, is illustrated. The Postal company is now using the current from dynamos in preference to that from batteries, at New York, Pittsburg and Chicago. The Chicago plant is operated by current from the power circuit of a local electric light company. The fact that the telegraph company thus places itself at the mercy, so to speak, of a company whose circuits although operated at a low tension are all underground, would seem to indicate that Chicago is maintaining its reputation for efficiency in underground electrical work.

MANY look upon the telephone companies as grasping monopolies, and are prone to believe that the service has been maintained with but, comparatively speaking, little expense. Without attempting to argue this question we would simply bring to the attention of the grumblers a fact which hitherto has, apparently, been ignored. In his address at the opening banquet of the Wisconsin Electric club, J. D. McLeod of the Wisconsin Telephone company, reminds us that the average life of the plant in the larger telephone exchanges does not exceed five years. "Unlike a railroad or an insurance company," says Mr. McLeod, "who have the wear and tear, or the average death risk computed to a certainty, we, on the other hand, meet the expansion of our business beyond a certain point by a complete renewal of a plant which yields no greater earning capacity until the enlarged facilities are employed. The business district of the Milwaukee exchange, has substantially been rebuilt three times."

Many telephone companies, perhaps, have money to spare but the unlooked-for yearly depreciation of 20 per cent. must have made a serious inroad into profits.

IN the last issue of the WESTERN ELECTRICIAN reference was made to the fact that St. Paul business men were jealously watching the progress of electric railway construction in their city and Minneapolis, and were beginning to protest that the street car company was giving the latter municipality too much attention, to the injury of the former city. It is interesting to watch the actions inspired by the perfectly natural rivalry between the twin cities. As stated in a brief article which appears in another column, St. Paul business men have appointed a committee to investigate why Minneapolis is more favored by the railway company. One of the members has already found evidence which leads him to believe that a deep-laid conspiracy exists, the object of which is to strike a blow at St. Paul. Residents of Minneapolis are the originators of the plot, and of course the street railway company is in league with these cunning conspirators. Every one knows how sensitive St. Paul is on the subject of its population; it is as jealous of the number of its inhabitants as of its good name. It is just here that the committeeman discovers the plot. The census enumerators will soon be at work, and St. Paul wants all its citizens to be on hand to be counted. But what have the wily plotters of Minneapolis done? They have made arrangements, according to the theory of this member of the committee, to cause a thousand workmen of St. Paul to move temporarily to Minneapolis, so as to find employment on the electric railway. They will be kept there till the count is made, and then the gang can be transferred to St. Paul to do the necessary work there. If the scheme succeeds St. Paul will have, according to the census returns, a thousand residents less than it should have, while the neighboring city will have a corresponding increase. One can scarcely believe that residents of St. Paul put faith in such a ridiculous story, but the committeeman in an interview makes the charge in these unmistakable terms: "I have an idea that there may be something in the way of a connection between the facts that Mr. Lowry has all his workmen in Minneapolis, and that the government is about to take the national census. A thousand or two of men taken off of St. Paul's population and rung in on that of Minneapolis would go quite a little ways toward making a difference between the two cities in the matter of population. He has to finish both the St. Paul and Minneapolis lines, but he thinks that he can put these off until his men are all counted as a part of Minneapolis' population." Amid all these turmoils and jealousies, plots and counterplots, the work of construction is progressing steadily, and we can express to the residents of the two cities our congratulations that they are to have such splendid systems of electric railways.

The Lodge Lightning Guard.

The accompanying cuts illustrate the device of Dr. Oliver J. Lodge for protecting cables and electrical apparatus from injury by lightning and high tension discharges in general. Its chief feature consists in placing a number of air gaps, or their equivalent, between the line and the apparatus to be protected. This principle, of course, admits of a variety of practical solutions, and in Fig. 1 is given a diagrammatic representation of one of the methods proposed by Dr.

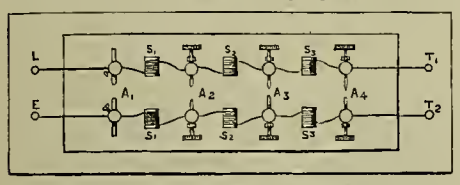


FIG. 1 LODGE LIGHTNING GUARD.

Lodge. L and E are terminals, connected respectively with the line and with earth; $T_1 T_2$ are terminals in connection with the instrument to be protected. A_1, A_2, A_3, A_4 are air gaps, and $S_1 S_1$, $S_2 S_2$, $S_3 S_3$ are impedance coils. The air gaps, it will be observed, decrease in width, and the wire composing the coils becomes gradually finer. The broad effect of this particular arrangement which, it should be added, is not greatly insisted on by its author, is to present an increasingly difficult path to the discharge in the direction of the instrument which it is required

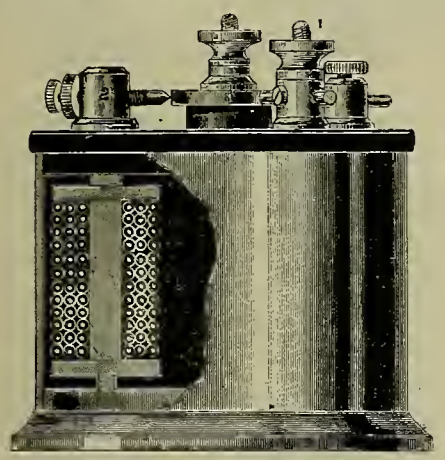


FIG. 2. LODGE LIGHTNING GUARD.

to protect, and an increasingly easy path to earth. The coils may be composed of the same wire throughout, the air gaps may be of the same width, and the terminals may be connected up in a variety of ways. A lightning conductor of this form, it is obvious, offers great self-induction on the one hand, and dielectric weakness on the other, to the lightning, and air-resistance obstruction on the one hand, and thick wire conduction on the other, to the useful current. The

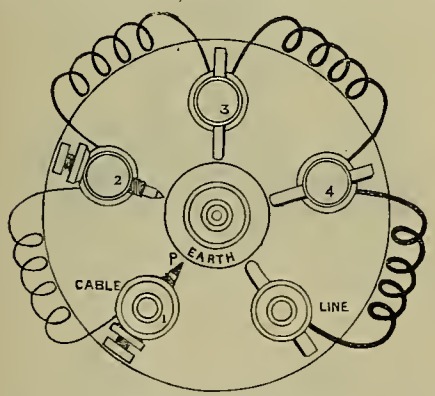


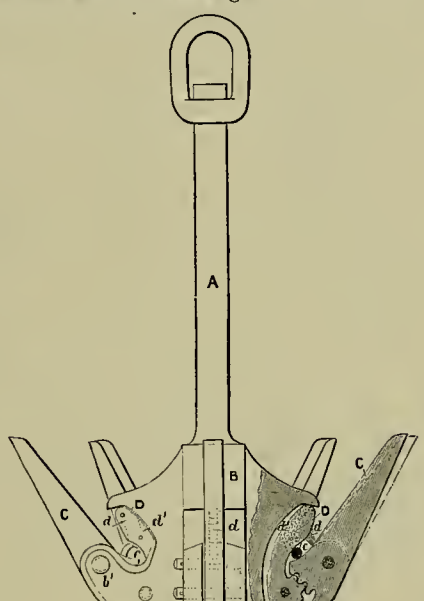
FIG. 3 LODGE LIGHTNING GUARD.

superiority of this device over ordinary single air-gap protectors, at any rate in the case of powerful discharges from a large Wimshurst machine, is most marked. It is unnecessary to add that the self-induction of the coils is inappreciable for ordinary currents, and that they contain no iron cores. In Fig. 2 is a perspective view and in Fig. 3 is given a diagram of the connections of an actual protector of the circular pattern, as constructed by Dr. Alexander Muirhead.

The central boss is connected to the brass case by means of a rod down the center. Underneath, in the base of the instrument, is a screw to which a direct connection with the earth is made. The screw on the central boss at the top is only used when a handy earth is wanted for an instrument. The first projecting rod is of platinum, the second of brass, and the remaining three are of copper This arrangement, it will be seen, is equivalent to that shown in Fig. 1, with the lower row of coils omitted. The cuts are reproduced from the London *Electrician*.

Cable Grapnel.

The object of the device shown in the cut is to provide a grapnel which will not merely hook a submerged cable, but will grip or hold the same fast when hooked. The essential feature is the conversion of the flukes into automatically acting gripping jaws. The stem or shank of the grapnel is fitted with a boss which forms a guide for leading the hooked cable into the position to be gripped. Below this boss the shank is fitted with a thick plate carrying forked extensions standing out radially for the reception each of a fluke which is pivoted thereto. These flukes may be described as bell-crank levers, the short arms of which are intended to receive the pressure of the cable as it is caught, and thus cause the flukes which are in action to rise from their open position and close upon the cable, and grip it against the boss of the grapnel. By this arrangement it will be understood that the act of hauling in the grapnel will have a tendency to increase the grip of the grapnel upon the cable which it has caught.



CABLE GRAPNEL.

The annexed figure shows in side elevation, partly in section, one of these improved grapnels, fitted with a locking device. In this arrangement, instead of using the fixed gripping surfaces forming part of the boss B, a second movable jaw, D, is provided, which, like the fluke C, is pivoted within the supporting arms extending horizontally from the boss. The jaws D are severally connected with their respective flukes C by interlocking teeth, which insure the simultaneous approach of the jaws C and D to grip the cable when the pressure of the hooked cable comes upon the surface c of the tail of the flukes. Each jaw is slotted longitudinally to receive a locking pawl d, and a tumbler d' situate below the pawl, and designed to move it into its locking position and retain it therein. These pieces, d d', are pivotally connected to the jaw D, and the end of the pawl, when in its locking position, enters a nick in the gripping face of the fluke C. The tumbler is so formed that, when not in action, its lower end will project somewhat from the gripping face of the jaw D, as shown on the left-hand side of the figure. This is for the purpose of enabling the cable, as it slides in between the gripping surfaces, to tip the tumbler d', and thereby bring into position the locking pawl d, as shown at the right-hand side of the figure. In order that the cable, while being hooked, may not be caught and lodge upon the top of the jaw piece D, the cast boss is formed with a web which projects so as to cover the jaw piece. The cable, it will thus be seen, being caught by the grapnel, and brought within the grip of the jaws C D, will be effectually prevented from escaping until released by hand after the recovered cable is suitably secured. The grapnel was invented by Henry Benent, of the Silvertown Works, England.

Wisconsin Electric Club Banquet.

The Wisconsin Electric club formally opened its club-rooms at Milwaukee Thursday evening, May 15th, under most favorable auspices. The club has been organized about three months, and has steadily increased in membership until it is now an influential factor in electrical matters in the Cream city. It includes among its members representatives of every branch of electrical science, and under the direction of its able president, Prof. A. J. Rogers, it may be expected to do good service in the promotion of electrical interests.

The rooms of the club are in the new Plankinton building, and they are admirably suited to the wants of the organization. In addition to the assembly room, there are reception and coat rooms, and the work of establishing a library will be undertaken at once. The meeting Thursday evening was the first in the new club rooms and was attended by all the members and many invited guests, including D. J. Whittemore, chief engineer of the Chicago, Milwaukee & St. Paul railroad; R. C. Spencer, E. H. Bottom, Milwaukee; John B. May, Watertown; A. C. Durborrow, Jr., and John B. O'Hara of the WESTERN ELECTRICIAN, Chicago. Following the meeting a banquet was served at the Commercial club. In opening the proceedings, Prof. Rogers said:

Three months ago our club came into existence. It was, in a sense, a spontaneous generation, and its germinating material very heterogeneous. Its individual units are business men engaged in electrical enterprises, investigators and inventors in electricity, and students anxious to know more of this great and growing science. The fusion of these elements promises to give us a live and energetic club in Milwaukee, which may not only be of great value to its own members, but also be a power for good in the city and state. We can never develop a class of intelligent electricians in this city unless an organization of this kind is maintained. The man who is searching after ideas in this occult science never fully grasps them until he has communicated them to some one else who is in intellectual sympathy with him. We aim to have this intellectual sympathy with each other in this club, and hope to be on common ground when considering questions in the practice or the theory of electricity. There was a time when about the only practical electricians were the lightning-rod men and the medical quacks. Now the practical electrician may be a reputable member of society, and his calling is coming to be placed upon a par with the other professions. To facilitate his advancement in the science and art of his profession, our club has an important function to perform. The business man, too, engaged in electrical enterprises, needs educating in the science he is applying, as well as the electrical expert who has to do with the technical details of his business. He must, at least, be able to distinguish between an intelligent electrician and a charlatan. How often do we find the cautious, safe and successful business man in the line he has studied and mastered, suddenly launch out into some new enterprise which to him is only a speculative scheme and means failure, while to the man educated in that direction, it means success. There is no reason why the great manufacturing city of Milwaukee, with its wealth and enterprise, should not be a great manufacturing center for electrical machinery and supplies if only its business men as well as electricians could be educated in that direction. This class of manufacturing is becoming very extensive, and the profits are large, and yet Milwaukee does practically none of it. Another mission to which we are not bound, but which I regard as very important, is to educate the public in electrical matters. There is no doubt but the educated children of the present generation will understand the meaning and use of volts, amperes and ohms as well as we of the present generation understand and use pounds, pints and feet. But the great mass of the people at present know little or nothing of this great subject. A leading city official objected to the introduction of street railways in Milwaukee on the ground that a horse or person touching the iron pole supporting the wires would meet with instant death. Many persons assert that they know that they are very strongly affected by the electric current when riding in the electric car; and a lady is reported to have been obliged to get out of the car because of the pain experienced from the action of the current upon her artificial teeth. A cautious and intelligent leading citizen and business man complacently asserted to me that he was going to get a chamois case to protect his gold watch from the magnetism of the street car. Now to assist these people to recognize electrical phenomena in their true light, to assist the business man to learn the best applications of electricity to practical ends, to aid the specialist in his work and the student in his investigations, are the chief aims and

ends of our club. Up to the present time we have had no permanent quarters in which to carry on our work; and now after three months of infant wanderings, we for the first time find a resting place and home in these cheerful, light and airy rooms. It is to be hoped that each member will find here a veritable intellectual and social home, and that he will make free to come at all leisure hours to enjoy its hospitality. We desire them to be a general headquarters for those wishing to get and to communicate the latest in electricity. Here we expect to have permanently on file and accessible, all the most recent and best in the literature of electricity in all its varied fields of application. Papers will be read and discussed by members and others at stated periods in theoretical and practical electricity. It is to be hoped that the rooms will be constantly occupied for reading, conference and club purposes. We further expect that no one in Milwaukee engaged in electrical work or study can afford to be outside the pale and influence of this organization. We are gathered here to-night for the first time in our cosy rooms to congratulate ourselves upon the progress we have thus far made, and to express our hopes for the future. For the club to reach its highest success, its members must be mutually helpful, and feel a personal responsibility in the work of the club, and give their best efforts to its welfare. I welcome to our rooms the members of the club, and also the few friends we have invited to assist us in enjoying the festivities of this occasion.

Letters from prominent scientists congratulating the members on organizing the club were read including messages from Elihu Thomson, Prof. Anthony, Prof. Rowland of Baltimore, and Prof. Davies of Madison. Many excellent addresses were made, all congratulating the members and expressing sympathy in the movement. One of the most interesting speeches of the evening was that by John D. McLeod, on the "Telephone." An abstract of his address follows:

In the letters patent of March 7, 1876, issued to Alexander Graham Bell, there was nothing, either in the very brief text or modest diagram of his discovery to indicate at that time, the place it was destined to hold in the economy and conduct of business, nor its thousand and one other uses which give it, clearly, first rank as the most beneficent invention of the age.

We read in the specifications that his claim is upon the discovery of the conveyance of articulate speech by means of an undulatory electrical current, and upon this fundamental principle his achievement stands. The medium for its employment, together with a magnet and a wire, was the full-fledged, perfect instrument we are using, without modification, to-day.

When the telephone was on its young legs here, a few years since, it was offered one of our discriminating capitalists who pooh-poohed it as of no commercial value, a toy; but in a decade we have three hundred thousand miles of wire, and four hundred thousand instruments in operation, while the numbers enlarge at the rate of thirty thousand per year.

It was related in my hearing recently that when our genial and scholarly friend, Haskins, was developing the swaddler—it is but a few years since—his assurance to certain capitalists was, that the Milwaukee exchange, in his judgment, would not stop short of three hundred subscribers. Telephone managers of that day would have considered four hundred millions of exchange messages per year, as the baseless fabric of a dream.

These early missionaries performed a monumental task with their first and second subscribers, and we cannot begrudge the reward of their pluck and tenacity. We latter day followers will seek in vain, but without envy, that golden hue adorning the horizon of the Old Timer from his point of view on the ground floor.

The operation of the telephone has to do with little things, small details, upon which depend efficiency, the refinement of methods, and the treatment and attention of each line as if it were the only subscribers' line in the exchange. It is made up of many pieces, and every joint must be honestly soldered—no slipshod work; it must not touch a leaf, nor come in contact at any point with anything but glass—no guesswork; its lightning arresters, a fuse metal no larger than the finest thread, must be carefully scrutinized at all cable heads; not one drop of water within the sheath of the cable, or its whole integrity is lost; not a moist finger upon any of the switchboard connections, or 25 per cent. of the efficiency of that line is lost for an hour; not an instant's delay in answering trouble calls, and no cessation of this vigilance any hour of the twenty-four, or any day in the year, not excepting the 4th of July. The public doubtless appreciates all this, but it is the religion of the telephone man, and in his conscience, barring a small stipend lies his whole reward. He is the object of contumely, but in his experience with the foibles of his fellows, he has learned to be "not like unto one of these," but in patience and long suffering, turns the other cheek.

The graduate of the telephone school should bear no resentments, he should be conspicuous by the thoroughness of all his work, and a sweetness of disposition under the adversities of his calling Troubles are his sole inheritance, and their remedy, his one pursuit in life He has been able, until recently, to control all the troubles incident to his business, aside from the troublesome subscribers and the effects of the elements, but to-day he is in the sorest straits by reason of the new and disastrous factor in the electrical world—disastrous only to the delicate organism of the telephone—and some early dispensation to mitigate this trouble is earnestly hoped for. It is desirable, from all points of view, that the lion and the lamb lie down together, but it is equally desirable that the lamb remain on the outside.

I am reminded by an incident in the experience of a gentleman present, to say a good word also for the subscriber, and to acknowledge that the telephone, and its quirks, is not always to him an unmixed joy. An error of one half an inch in the switch-board, called up this weary citizen in the dead of night to answer perhaps a lunch house, and we find it very difficult to compromise with him, for either the senseless disturbance, or the carpet tacks in his feet. To err is human, to forgive is divine, but in cases of this nature one's complete impotence before the machine ends in an explosion, and the supercharge of wrath is discounted on the spot and charged up to the telephone.

The maintenance of telephone systems has presented many startling surprises to its investors, and confirms the statement of the parent company, that the average life of the plant does not exceed five years in the larger exchanges. Unlike a railroad or insurance company, who have the wear and tear, or the average death risk computed to a certainty, we, on the other hand, meet the expansion of our business beyond a certain point by a complete renewal of a plant which yields no greater earning capacity until the enlarged facilities are employed. The business district of the Milwaukee exchange has substantially been rebuilt three times, and it may be interesting to outline briefly the present work in hand, as it means a very great improvement to the city.

Our sub-ways cover that district between Mason street and Broadway bridge on the south, and from Jefferson street to the river on the west. The cables, now in place, contain from 100 to 140 wires each, or in all 875 miles of wire. The necessity for a fire-proof building in connection with this work was an imperative one, not wholly on account of the danger of personal loss by fire, but to assure the service to the city, which could not in such an event, be restored under four or six months. We have been obliged, also, to provide a new switch-board which is arranged at present for 2,400 subscribers with an ultimate capacity of 4,000, together with all modernized apparatus for tests, measurements, etc. The cost of this board as fully equipped for 2,400, will be $40,000.

It is obvious that a plant of this nature cannot be built for a day, but must of necessity provide for the growth of years, consequently we have placed a generous number of idle wires at each terminal head, and have constructed our conduits for those who will follow us. We expect to be in operation within thirty days, and the poles and wires in this district are to be removed as soon as possible. The hub-bub of the operating room, under the early methods, was worse than a kindergarden let loose, and the subscribers' connection depended upon the time it took a boy to go on the double quick from the caller's end of the board to the subscriber's jack at the other, perhaps sixty feet away. The operator now sits comfortably at the board and is enabled to connect instantly any two circuits in the exchange. The connection between sub-way cables and the switch-board requires 264 miles of wire, and as each subscribers' line requires 47 soldered connections, we have, therefore, including our toll table, 117,000 soldered connections within the building. When it is understood that it requires the labor of twenty men for sixty days to connect these wires alone, the business public may take a measure of comfort, as we do, in the confidence it cannot be destroyed in an hour.

The need for the telephone, like the appetite for sin, seems to grow by what it feeds upon, and it is reasonable to expect, when it reaches years of maturity, we will have it in every household and converse across the continent as readily as we now postpone lunch.

The long distance people have reached such a standard of perfection we can hardly look for much greater efficiency in the future although they will not accept their present results as the limit of their expectations. Their system is very comprehensive, and is in operation to-day between Buffalo and New York and along the coast from Boston to Washington, with feeder lines in the several states. They have given on their lines without a break absolutely certain service, and equal to that now given in the short stretch between here and Chicago, regardless of distance or atmospheric conditions. I have talked with utmost ease between Buffalo and Boston, distance of about 850 wire miles, and the Falls of Niagara can be heard in New York or Boston with perfect distinctness. They expect for it the annihilation of mere distance.

Its usefulness is extending to many and diverse interests. The factory, say 300 miles away, is in easy communication with its New York headquarters. Partners in New York, Boston or Philadelphia are practically as one in the sudden turn of trade. The railway manager arranges his time card with his assistant across possibly several states, and the news gatherer in a few minutes talks out his budget for the day straight into the ear of the type writer at the home office. After the weary grind of business it will then furnish you the restful diversion of any of the operas, and that in cap and slippers under your own vine and fig tree.

Mr. Bellamy presents the telephone in "Looking Backward" as a principal factor in our future happiness, and introduces us to the "telephone room" where we have the whole world within reach—the various operas, the drama and spiritual food of all creeds on tap, so to speak. Mr. Bellamy did not in this instance puncture the future to any great extent for while this Utopian dream was upon him, a certain old lady in Brooklyn had in fact for some time been enjoying her favorite preacher at the end of a wire connected with the tabernacle. Through the medium of the Woman's Exchange exhibition at the Lennox Lyceum in New York within the last week, parties in Boston were enabled, by the aid of a long distance telephone, to hear the performances at the various New York theatres. In this way Miss Lillian Russell in the "Grand Duchess" at the Casino, offered enjoyment to several Bostonians sitting in their parlors 275 miles away. Who can say we have gone beyond the mere dawn of the art or that the telephone will not in many ways now unknown to us further ameliorate social conditions and offer us as many surprises for the future as it has given us in the past?

John B. May responded gracefully to the sentiment "The advancement and application of electricity in our state." He was followed by E. H. Bottum on "Electric Cranks." A. J. Shaw entertained the company with a pleasing address, but carefully avoided explaining the mysteries of "Electric Cranes." D. J. Whittemore found the task of telling what he "doesn't know about electricity" too great and therefore abandoned it. He made an interesting address, however, urging the members to work in harmony for the advancement of the interests of electrical science. W. C. Schaeffer's response on the "Automatic Fire Alarm" was received with favor, and Harry Sawyer's remarks on "Electrocution" were appreciated. His protest against the employment of electricity for inflicting capital punishment was received with applause. "The Electric Telegraph" had a worthy advocate in Peter McGill, a veteran in the service, and his response was an eloquent effort. John B. O'Hara responded to the sentiment "The Electric Press," and R. C. Spencer "The People and Electricity." Mr. Spencer, who has devoted his life to educational work, said that the new field presented by electrical science required the attention of all who were interested in the work of education. The masses should be made acquainted with the principles governing the application of electricity, and when they were informed on this subject the bulk of the opposition to the introduction of electricity would disappear. H. D. Goodwin explained the mechanism of the phonograph and the part it is destined to play in commercial life. This was followed by an exhibition of the machine in operation. After this the president called on several members for speeches, and the proceedings were closed, every one voting the opening of the club rooms an occasion for congratulation.

Ayrton and Perry's Twisted Strip Voltmeter.[1]

At the Physical society some years ago I announced that a strip of material, to which a permanent twist had been given, behaved in much the same way as one of our now well-known springs; that is, when it was acted upon by axial forces, there was a relative rotation of the ends; in

FIG. 1. TWISTED STRIP VOLTMETER.

fact, the twist gets less. As some people have a difficulty in understanding what I mean by a twisted strip, I have prepared Fig. 1 to illustrate my meaning. The relative rotation is perhaps better seen in a strip whose permanent twist is right handed at one end and left-handed at the other. If a pointer be attached to the middle, as shown at *A*, *Q*, *B*, Fig. 2, and the ends are pulled out, the pointer rotates. This double-twisted strip we have applied to weighing machines, aneroid barometers, and many other instruments, such as wire-testing machines, and I can recommend its use in all cases where a force has to be measured, and where it is not advisable that there should be a considerable amount of yielding. For example, spring balances are sometimes used acting directly on specimens as testing machines; but when the specimen breaks, the recoil of the balance is likely to cause it to get out of order. Again, if a double-twisted strip is used as a tension piece in a jointed structure, a pointer set at its middle will indicate the pull at any time.[2]

The only likely suppositions I could make in thinking of what occurs in a twisted strip were, first, that two spiral filaments symmetrically disposed relatively to the axis resembled the two threads in a bifilar suspension, if a sufficiently short length of strip was considered; second, that the tensile stress was uniform over a cross-section of the strip at right angles to the axis; third, that the resisting couple was due to the torsional rigidity of the section of

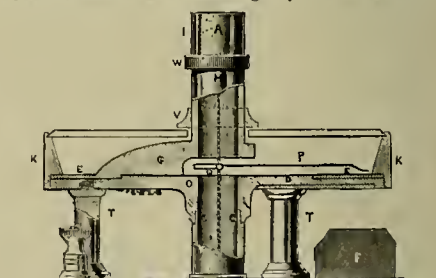


FIG. 2. TWISTED STRIP VOLTMETER.

the strip, still taken as rectangular. These suppositions lead to the result

$$\phi \propto \frac{W l n b}{t^3},$$

where W is the axial force, l the length of strip, n the number of complete spires given by permanent set to unit length of the strip, b the breadth of the strip, and t its thickness, ϕ being the small rotation produced by the small load W.

Now, such experiments as I have hitherto made on steel strips point rather to some such law as the following being roughly correct:

$$\phi \propto \frac{W l}{b t^3}.$$

[1] Read at the British Association meeting by Prof. John Perry.

[2] The above paper is given as it was written in September last When it was written the author felt certain of the constancy of the fatigued strips. Six months of further experience have since confirmed his views.

That is, the rotation seems to be independent of the amount of twist originally in the strip, and instead of increasing as the breadth of the strip increases, it diminishes. It is evident that the motion is a much more complicated one than I had imagined. Now, I found that if a double-twisted strip was placed in tension and its ends were fixed, the pointer rotated if the temperature was altered, so that its use as a pyrometer or thermometer was possible.

In this instrument before you (Figs. 2 and 3). we have a tube, *A*, *H*, *D*, *C*, *B*, about two-thirds of whose length, *A*, *H*, *D*, is brass, and about one-third, *C*, *B*, is iron. A double-twisted strip of platinum silver is in tension in the axis of the tube, with its ends fastened to the ends of the tube, but one of them electrically insulated from the tube. The tube just at the middle of its length, *D*, *G*, becomes a strong thin bracket, which enables a pointer, *Q*, *P*, attached to the strip to make a rotation of nearly 360 , and the arrangement of the bezel and dial will readily be un-

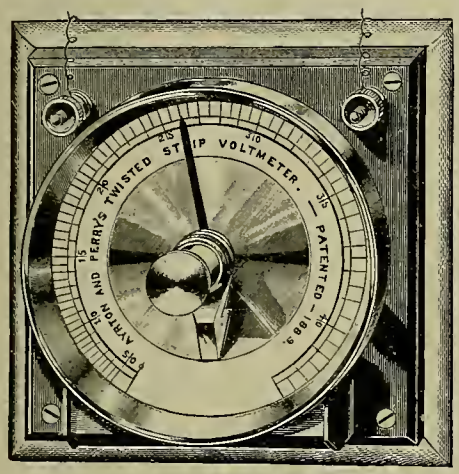


FIG. 3. TWISTED STRIP VOLTMETER.

derstood without any further description. *A* and *B* are caps to the ends of the tube; when the cap *A* is turned the initial pull in the strip is altered, and this furnishes a zero adjustment.

When the various parts of this instrument are all at the same temperature the pointer remains in the same position, whatever that temperature may be. When a current is passed through the strip the pointer records the difference of temperature between the strip and its case, and hence the readings on the dial may be made in amperes. Again, the readings may be in volts for the potential difference between the ends of the strip or the terminals of the instrument. These instruments before you read to two and a half volts; they waste almost exactly *one watt* at their highest reading.

By inserting resistance of platinoid or of German silver we can increase the range of the instrument, but of course we expend more energy in such a case.

That there may be no creeping or permanent set or hysteresis, we find it sufficient before graduation of the in-

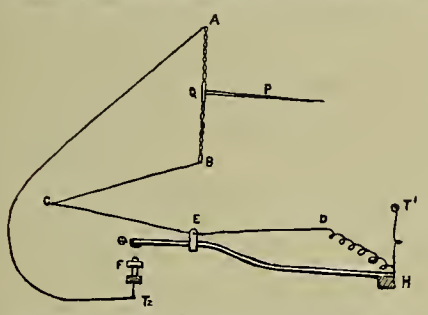


FIG. 4. TWISTED STRIP VOLTMETER.

strument to keep sending a current greater than the highest which is to be used on the instrument for seventy-two hours, breaking and making the current once in every minute. This process is performed by the second's hand of a clock passing into and out of a bath of mercury in every revolution.

It is quite wonderful to observe the complete change in elasticity produced in a strip by this kind of fatigue. The strip seems to undergo no alteration afterward by mere use or disuse, but it is my intention to test this by many months' experience before allowing these instruments to be manufactured. The two instruments before you are the only two yet made.

I had hoped to be able to show you one in which the strip is of flashed carbon. Here are specimens of twisted carbon strips, but unfortunately they are all too coarse for a 50-volt instrument, which is what I intended them for.

For accumulator work the 2½-volt instrument is greatly needed, and I prefer this form to our hot-wire instrument, because of its great simplicity, and its needing so very little adjustment in manufacture.

For alternating currents this 2½-volt instrument may be used through any range whatever by placing a small transformer on the base of the instrument. The little transformer before you transforms in the proportion of fifty volts to one, so that the instrument may be used on the ordinary 100 or 110-volt circuits. By using a different winding on the transformer the same instrument may be graduated for a 1,000-volt circuit. I find that this transformer maintains the same proportionate transformation of voltage, whether the frequency of alternation of current is 50 or 100 per second.

This pleasing result was not altogether unexpected, but it certainly was unexpected to find that if a sufficient quantity of iron is used in the transformer there is a constant ratio of transformation of current for quite different frequencies of alternation. Hence I find that this 2½-volt instrument may be graduated as an ammeter up to 1,000 amperes or more, or a voltmeter up to 1,000 volts or more, the transformer being the only variable thing about it. I need hardly say that with several transformers and resistance coils at the side of this instrument we may almost call it a universal instrument.

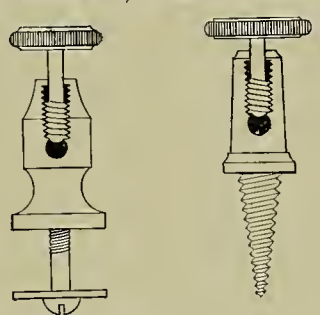
Added later.—Fig 4 shows our fuse arrangement—T_1 and T_2 are the terminals of the instrument; current flows from T_1 through the short thin copper wire, T_1, H, then through the adjustable resistance coil, H, D, then through the tightened platinum silver wire, D, E, C, whose ends are fixed, and which is kept sagged and tight by the metal spring, H, G; then through the twisted strip, B, A, to the terminal, T_2. But should the voltage between T_1 and T_2 be so great as to be liable to hurt the instrument, the wire, D, E, C, sags so much that the end, G, of the spring short circuits the instrument through G, H, and the thin copper wire, H, T_1, the copper wire being instantly melted.

Telephone and Telegraph Wires Buried.

The Commissioner of Public Works of Chicago issued permits May 12 to the Chicago Telephone company to remove its lines from poles and place them in a conduit between Polk and Twenty-second streets on Clark street, and to the Western Union company to run a conduit for the same purpose on Canal street from Kinzie to Sixteenth Street.

Delany Binding Post.

In the accompanying cut is illustrated the Delany security binding post. The screw of the new binding post cannot come out. It backs out just far enough to clear the hole, but no further. The thread of the screw is on a shoulder larger than the stem, and as the neck of the cup



DELANY BINDING POST.

is turned over tight up to the stem, the screw part cannot pass. The binding posts are made in all sizes. One great advantage of the new post is, that when wiring has to be done in dark and difficult places, it can be known with certainty that the wire hole is clear when the screw is withdrawn to the limit. The E. S. Greeley & Co., of New York, manufacture the binding post.

Gas Explosions in Chicago.

Commissioner of Public Works Purdy has sent the following to all underground wire companies in Chicago:

"Owing to the recent dangerous explosions which have occurred at different manholes in this city, I wish to call your attention once more to this subject. It has been claimed by various companies owning and operating underground wires and conduits that these explosions can not be avoided, and they can suggest no remedy for the same. In this connection I wish to inform you that Prof. Barrett, our city electrician, has, by making connection with the chimney at the city hall, created a draught through his conduits which carries off all the gases that produce such explosions, thus proving that the explosions may be avoided if similar precautions are taken by the various underground companies.

"You are hereby urged and requested to take the necessary precautions at once looking to the avoidance of similar accidents. I would suggest that you place yourself in communication with Prof. Barrett upon this subject, and I would also suggest that possibly the tall chimneys on buildings conveniently located might, with the consent of owners, be used."

The construction of the gas mains in Chicago is probably worse than in any other city in the country, and the nuisance thus caused is one of the greatest evils which the city has to contend with. Streets are being constantly torn up, and whether for the purpose of repairing gas pipes or reaching sewer or water pipes or the electrical conduit, the result is the same. As soon as the earth is disturbed, the offensive odor from the escaping gas makes life in the vicinity of the opening almost unbearable. The effect of this escaping gas on the public health is not salutary. Then, again, this gas not only permeates the earth, but reaches the cellars, and through them the houses of the people. It finds its way into the conduits of the electrical companies, and the action upon the cable is, of course, injurious. But more than this, it is a constant menace to life and property unless the greatest care is exercised on the part of the electrical companies in ventilating the conduits. Explosions are liable to occur at any moment in poorly ventilated conduits with disastrous effects. Gas companies should be held strictly accountable for any accidents that may occur.

New York Electrical Society.

At the meeting of the New York Electrical Society, May 15, George H. Guy presented his annual report, of which a synopsis follows:

The work of the society has been steadily progressing during the past year. The number of members now on the roll is 250. During the year 40 new members have been elected, and there have been four resignations, so the net gain in membership is 36. The society has been able to provide an excellent course of lectures, which have not only been received with appreciation by the members and their friends, but have secured from the press a recognition which is gratifying and encouraging.

A recapitulation of the subjects treated of at the various meetings will enable you to judge of the manner in which the society has endeavored to carry out its work.

W. J. Jenks gave a paper on the "Practical Working of the Edison Three-wire System." A. A. Knudson spoke on "Electrical Exhibitions." Joseph Wetzler told of what they are doing in that line in Europe. Our worthy president lectured on how to test electric motors. S. Dana Greene gave us the "Development of Electric Street Car Traction." Joseph Wetzler ushered in 1890 with his lecture on the electrical progress of the year, which has now become a recognized feature in the society's programme. Herbert Laws Webb broke new ground in his paper on the "Construction and Laying of Submarine Cables," and a very full house attended the "Phonograph Evening." T. C. Martin read a paper on "The Social Side of the Electric Railway." In consequence of the number of inquiries about this paper the society has been induced to publish it, and several thousand copies have been sold at cost to the leading electric railway companies in the country for missionary purposes. By way of giving a practical exposition of the alternating current, a subject that is now attracting such universal attention, the society called its members together one evening at the Equitable building, and the Westinghouse company made them welcome at its exhibition plant there. The last meeting was held at the Lenox Lyceum, to inspect the fine collection of Edison inventions and apparatus, and a large number availed themselves of the opportunity of seeing the beautiful electrical exhibition there. For the next season the executive committee has in contemplation plans which it is hoped will more than maintain the prestige and influence which the society has so honorably gained during its many years of existence as the oldest body of the kind in the country.

I cannot close this report without a reference to Columbia College, at whose hall we meet to-night. It is gratifying to see this seat of learning is discharging its duty to the fullest degree when, in addition to following out the developments of higher education it places itself in touch and closest intimacy with such a society as this, which seeks to make the latest researches of the scientist and the investigator common property and a benefaction to all.

The society elected the following officers: President, F. B. Crocker; vice-presidents, Joseph Wetzler, Francis Forbes, Dr. Otto A. Moses, T. C. Martin, G. H. Stockbridge, E. L. Bradley; secretary, Geo. H. Guy; treasurer, H A. Sinclair; trustees, C. O. Mailloux, F. B Crocker, Joseph Wetzler.

Great Western Electrical Supply Company.

A syndicate has been formed for the purpose of controlling a number of electrical supply houses throughout the west. It will be known as the Great Western Electrical Supply company, and it will deal in every line of electrical goods. Chicago has been selected as the center of this great combination, and it will be the purchasing and distributing point for the system. The facilities for conducting this business in Chicago are obtainable at no other point; moreover, this city is now recognized as the electrical center of the west, and the project will be a strictly western enterprise. A large building at Nos. 190 and 192 Fifth avenue has been leased for five years, and possession has already been taken. It will occupy the entire building, which comprises five floors and a basement, each 42 by 90 feet. This will give an immense floor space. It is admirably arranged for the purpose to which it will now be put. All the floors are provided with ample light. An excellent opportunity is afforded for handling freight at the rear of the building and the freigh. elevator will soon be supplemented by a fine passenger elevator

near the front of the store. Everything will be done to make the place attractive to patrons.

The first floor will be fitted up for displaying stock, and used as a salesroom. On the second floor handsome offices will be furnished, and the rest of the building will be filled with stock.

George Cutter of Chicago will be manager of the enterprise and he has transferred his business to the new concern. He is already moving into the new building. Mr. Cutter is well known in electrical circles throughout the country, particularly in the west. He was associated with Thomson-Houston interests in Chicago as electrical expert and about a year ago started out for himself. He opened an electrical supply house on Adams street and secured the agency of several excellent lines and has proved as energetic and able in the management of his commercial enterprise as he formerly showed himself in his work as an electrical engineer. His knowledge of electrical science has proved valuable in his experience during the last year, and much of his success can no doubt be attributed to that. His friends throughout the country will be pleased at the new evidence of prosperity, and all will earnestly wish him a continuance of the success he has enjoyed during the last year.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 17.—The street lighting question is assuming a magnitude which cannot be easily settled. Suspicion in every direction where a corporation is serving the public has become so prominent a characteristic of the mayor that nothing seems to him to be in good faith, and the shadow of a combination scheme is always following him. His instructions to Corporation Counsel Clark to send a letter to Gov. Hill asking him to examine closely the amendment to an act authorizing the consolidation of manufacturing companies as it might be a scheme of the gas and electric light companies to effect a combination against the city's interests, is certainly going to an extreme. The fact that all the electric lights used by the city prior to May 1 are still maintained by the electric light companies is attesting the good faith of the companies to serve the public, and their belief that the controversy with the gas commission will bring the mayor to a recognition of the rights of the electric companies. The bid of the Standard Gas Lighting company was opened during the week, and on the motion of Commissioner Gilroy the bid was referred to the mayor with power to execute contract. It is said that the city will save a considerable amount of money by accepting the bid of the Standard company which did not put in a bid at the annual letting on account of its charter to light the city lamps at an annual charge of $12.50 per lamp. The new bid is for lamps which are costing the city at the rate of $20, for which the Standard proposes to get $13.04.

The meeting of the Board of Electrical Control was of a nature still further to antagonize the mayor and the Subway company. This time the police department is the complainant charging the Consolidated Subway company with refusal and neglect to furnish a conduit for its wires. The Consolidated company desired that the police department place its wires in the same conduit with the fire department on the ground of its entire feasibilty, as electrical experts find that there is no danger of interference. Fire Commissioner Robbins wished to be put on record as saying that the proposition of the Subway company is impracticable, and that if the police and fire department are compelled to place the wires in the same duct the whole city will be endangered. Mr. Lauterbach of the Consolidated company says this idea is all nonsense. The engineer and expert of the Board of Electrical Control will examine into the matter and both sides are content to abide by the decision, although the mayor thinks that the police and fire departments are the only judges of what they need.

At the previous meeting of the board it was understood that the electric lighting companies would be able to determine and report at its next meeting what ducts were necessary so that the contracts for repaving the streets could be entered into, but the companies failed to find this out. Mayor Grant's ire was immediately kindled, and he said that rather than wait any longer he would order Commissioner Gilroy to go ahead with repaving without regard to the subways, and that he would order every wire cut down. The electric companies will submit their revised applications at the next meeting on Monday.

The closing entertainment of the Electrical Exhibition at the Lenox Lyceum drew an audience which filled every seat in the immense auditorium. The illumination of the electrical tower every fifteen minutes during the evening, and the presentation of a beautiful solid silver vase to A. B. DeFreece, managing director of the exhibition, were the features of the last evening of a most successful undertaking in the interests of the Woman's Exchange.

The reopening of a copper mine at Bristol, Conn., is bringing to light a rich copper bearing stratum at the depth of 180 feet. A mass of rich ore has been struck, being a vein ten inches in thickness, an assay of which shows 75 per cent. copper and 16 ounces of silver to the ton. This vein scatters and the whole rock in either direction is streaked with the same rich ore.

The New York Electrical society which has had such a successful series of meetings during the current season called together its executive committee on the 15th inst. to consider the relation of the society to the American Institute of which it has been for some time the electrical section. After a careful and thorough consideration of the matter by a full board of officers and trustees of the society, a resolution was passed by virtue of which the society severs its connection with the American Institute and resumes all its functions of self-government and independence of action. The society is now doing excellent work, and is in a most flourishing condition.

The last traces of the once "only conduit system for street railways" is disappearing in Fulton street thoroughfare and the cross-town horse car is evidently showing how to make progress in the metropolitan city. Electricity has had to struggle with municipal mismanagement in every direction within this great corporation.

The New York papers have not yet lost interest in the electrical execution law, and the *Sun* continues to pay its respects to gentlemen who are responsible for it. The question of solitary confinement, which is undoubtedly opposed to the spirit of the constitution, is being aired in its columns every day. Another feature of the law, by which all knowledge of the day of execution is withheld from the prisoner is opposed to the object which the projectors of the new system declared they desired to attain. The *Sun* says: "Irrespective of any question as to the particular method by which death is to be inflicted, it has always seemed to us a most cruel and inhuman device to leave the convict uncertain as to the day when he is to die. He knows that he is to be executed at some time within a specified week. After that week begins, any knock at his door may be a summons to the executioner's chair, or merely an announcement that some meal is in readiness. He may be forced to pass six days in a state of dreadful suspense and anticipation, as cruel as it is needless." Justice Miller of the Supreme court of the United States in passing on that same question in the Medley case, expressed the same views. W. H. T.

Louisville, Ky.

LOUISVILLE, Ky., May 17.—The development of the new South now taking place is simply marvelous and almost incredible, except to those who have been in the heart of the "boom" district within the past few weeks. As all these new towns are depending upon electricity for light, and in a great many cases for street car tramway lines and for other power, the "boom" is of great importance to the electrical world. Millions of capital from England and the East are seeking investment, and men for working the mines, and sawmills cannot turn out the products fast enough unless they work day and night. Gas works are in operation in only a few of the smaller towns, and even in many of these places electric lights are being generally substituted.

Including Louisville, Nashville and Birmingham, which are the representatives of the "boom" district, there are forty-two "boom" towns, in nearly all of which there are already electric light plants either in operation, in process of construction, or under contract. Most of the large ones have power and street car companies that depend on electricity, and it has been judged economical to use electricity on the coal and timber railways constructed through the mountain spurs and the valleys. Seven states are represented in the great development of the coal, iron and timber region of the Appalachian system, one of which, however—West Virginia—is not represented by any considerably-sized town in the "boom." The other states are Kentucky, represented by eighteen towns; Tennessee, by thirteen; Alabama, by six; Virginia by two, and Georgia by three.

Ashland, Ky., already has electric lights, and so have Owensboro, Fordsville, Beattyville, Clay City, Pineville, Winchester and Middleborough, Ky.; New Decatur and Sheffield, Ala.; Barboursville, Ky., Cardiff and Deptford, Tenn., East Chattanooga, Tenn., Grand Rivers, Ky., Harriman and Johnson City, Tenn., Piedmont, Ala., Rome, Ga., Rockwood and South Pittsburgh, Tenn., and Somerset, Ky. If the plants in all of these towns are not already in operation they are almost completed. Ashland has a large electric light plant, both for streets, business houses and homes.

Among the first things provided by the Middleborough company was an electric plant for street illumination. A Thomson-Houston system was used, with a dynamo capacity of 100 arc lamps. More than fifty are now in use. A plant for furnishing incandescent lights is also contemplated in the near future. In fact, a good portion of the machinery is now in position. An electric tramway for passenger traffic and coal lines is contemplated.

Owensboro has a large electric light plant and the streets are lighted by electricity exclusively. There is talk of turning the street car system there into an electric line.

New Decatur has a splendid electric light plant. Barboursville's plant was just completed a few weeks ago. A $50,000 light plant is contracted for at East Chattanooga. Piedmont has an electric light plant in process of construction. Rockwood, Tenn., has an adequate plant. At Tallapoosa, Ga., is an Edison light plant employing ten hands.

Most of the following have plans under consideration for electric lighting, and a number probably have contracts let: Big Stone Gap, Ky., Bridgeport, Ala., Bristol, Va., and Tenn., Centralia, Ky., Cumberland Gap, Ky., East Big Stone Gap, Va., Falls of Rough, Ky., Ford, Ky., Kingston, Ga., Riverton, Ala., Spring City, Tenn., Falmouth, Ky., and Marion, N. C.

In many respects Centralia is the most remarkable town of them all. It is conducted on the soundest of business principles but it is solely for colored people. N. R. Harper, a colored attorney of this city, is chief promoter. He recently stated that his little city would have telephones, electric lights, and the electric roads as soon as possible. Centralia is about fourteen miles from the city on the Louisville Southern.

Mayor Jacob has signed the ordinance granting to the Gooch Electrical company the right to lay conduits and wires through the streets of this city. The company's chief business is to supply power.

At the stockholders' meeting of the Cumberland Telephone & Teleg aph company at Henderson, Ky., the 13th inst., James E. Caldwell was elected president and general manager.

The Green street electric street car line, operated by the Central Passenger Railway company in this city, will be extended down Walnut street, and probably in other directions as soon as the pending suits in chancery are settled. L.

Milwaukee, Wis.

MILWAUKEE, Wis., May 17.—Two electric railway lines have now been in operation here for several weeks, but no trouble has been experienced by users of telephones. It was predicted on all sides that the advent of the electric car would seriously impair, perhaps destroy the city telephone service. Everybody supposed that the trouble at Eau Claire would be repeated here. In the Eau Claire case, which has become quite famous, the court decided, in substance, that the public streets were maintained for the purpose of travel, and that if the electric car interfered with the telephone, the telephone company, not the railway company, would have to stand the consequences. Had the question arisen here, and such a decision been made, the Wisconsin Telephone company would either have had to bury all its wires, at an expense of more than $1,000,000, or retire from business. The fact that the trouble has not materialized, probably delights everybody. Your correspondent uses the telephone very frequently, perhaps as often as anybody in the city, but has only experienced any kind of trouble from the whirring three or four times. In but one case, so far as his knowledge goes, has the induction of the electric railway drowned conversation over the telephone wire.

On the toll lines, however, the case is different. These lines have always tried one's ears more than the city wires, and the difficulty in using them has certainly been increased by the electric street railways. There is some talk of the telephone company putting in return wires. If this is done the telephone rates, which are now as low as $40 in some cases, will be increased from $10 to $20.

A switch-board which cost about $40,000 is among the improvements which the Wisconsin Telephone company is putting in at its Milwaukee exchange. It is about sixty feet long, and is fitted up so as to afford connections for 2,400 telephones, about 200 more than are now in use in the city. Two wires have been provided for each telephone, so that every instrument may have a metallic circuit. The company's new building is practically fireproof, and the valuable apparatus will be quite safe. Iron, fire-clay and brick have taken the place of wood in the walls, floors and staircases. The general plan of the new building is the same as that of the Telephone exchange on Thirty-eighth street, in New York. The Broadway front, which at present hides the new structure in the rear, will be raised soon so as to permit the completion of the work. The company's underground system, in the business district on the east side, was to have been ready for use on January 1, but it will be July 1 before everything is completed. The cables, thirty-two in number, extend from a huge chamber under Broadway to the rear of the basement, and are so arranged that any particular cable can be removed without disturbing the others. In the basement each cable ends in a "head," and the wires, separated and attached to numbered binding screws, are there connected with the switch-board.

The Milwaukee City Railway company is considering the advisability of adopting a storage battery system for its cars.

Cables and conduits for the Milwaukee Edison Electric Light company are being shipped here from the east, and the contract for placing the wires underground will be let next week. Work on the company's power house will be commenced in about a week. The building will occupy 100 feet on River street and 115 feet on Oneida street. It will be of brick and iron, and two stories high. The company's offices will be located in the building. The size of the machinery plant will depend on the lighting contracts made this summer, but it is intended eventually to provide a very large capacity for furnishing light and power. At first only the incandescent light will be furnished.

Mayor Peck fears that the speed at which electric cars are run, and the recklessness that the drivers sometimes display in stopping on almost the very brink of the river, when the bridge is open, may some day result in a car plunging into the water. He declares that electric cars, unlike horse cars and mule cars, can go too fast. He states that he hears that some of the electric cars run at the rate of twenty miles an hour at night. He announces his intention of reforming rapid transit if he has to invoke the aid of the law. P.

Des Moines, Ia.

DES MOINES, May 15.—Not only is there a decided advance in this city in electric railway and power business, but the forward movement is noticeable all along the line. A unique project is that of the owners of the water power of the Des Moines river. They are rebuilding and raising the dam, and are at work on a fine large building to replace the old flour mill, and to be used as an electric power house. The company expects to operate the present Belt Line railway with electricity, and to furnish power for machinery in all parts of the city. A large building will also be put up to be used for factory purposes, floor space, and power to be rented out to companies starting in manufacturing business. The water power is great, and the plant can be operated very cheaply.

The greatest addition to Des Moines' electrical circles is the new power house of the Edison Electric Light company, a handsome brick structure 98x115 feet in size with handsome office rooms, and complete dynamo and boiler rooms. The building is finished, and all the machinery will be in place in another month. Two Williams compound condensing engines, 100 and 150 horse power respectively, have been placed, and a 150 horse power Buckeye will be brought from the present station. These will drive four No. 20 Standard dynamos and two No. 12, which will give a capacity of about 5,000 lights, though the station is designed for 12,000 lights. Two 200 horse power Heine water-tube boilers are being placed in addition to one 150-horse power plain boiler. The smoke stack is 125 feet high and six feet square inside. The company will make an expenditure of $70,000 or $80,000 on this plant, and claims that it will have the largest and best station west of Chicago. The officers in the company

are J. H. McClement, president; J. S. Clark, vice-president; J. G. Rounds, treasurer; J. A. Colby, secretary and manager. The plaot has been constructed by the United Edison Manufacturiog company of New York, under direction of August Hansen, and the line work is in charge of Wm. H. Bander.

The other Des Moines companies are the Capital City Electric Light company, and the Thomson-Houston company, both having the same officers, viz.: S. T. Bodine, president; M. T. Wright, treasurer; E. G. Pratt, secretary; E. M. Cobb, electrician; Joseph Deemer, superintendent. These companies are identical with the gas light company which now owns them. An elegant power house has been fitted up since the consolidation, and the capacity has been increased. One Westinghouse 80-horse power engine, and four Armington & Sims engines with a total of 346-horse power, are used. Seven Thomson-Houston dynamos are used with a capacity for 230 arc lights. Westinghouse and Thomson-Houston alternating systems are used with a capacity for 1,640 lights, though 2,300 lights are now on the lines. The company has been extending its circuits rapidly out into the suburbs, and has in contemplation a number of improvements.

The increased use of electric light and electric power in Des Moines is noticeable. Nearly every printing office and small factory in the city has abandoned steam engines, and the city is being literally covered with wires.

O. W.

Boston, Mass.

BOSTON, May 17.—Massachusetts has but one storage battery electric railway in operation at the present time. This is the road between Beverly and Danvers, with only a small equipment. Another road is now projected, however, in a suburb of Boston, which will, if the plans are carried out, be equipped with the system of the Union Electric Car company, the same as that now in operation at Beverly. The proposed route extends from Newtonville to Newton Highlands and Newton Center, and returns by a different street to Newtonville.

The West End Street Railway company has petitioned the authorities in Brookline for the right to extend its tracks. At a hearing this week, a protest was entered by F. A. Houston, who appeared as a remonstrant for the New England Telegraph & Telephone company. He said that he objected to the single trolley system on general grounds.

In the state senate this week the bill relating to fenders and guards on electric cars was passed to be engrossed, with an amendment striking out the provision that the act shall go into effect on its passage. The bill relating to the regulation and control of overhead wires in cities was also passed, to be engrossed by the senate without discussion. The bill concerning the inspection of electric lights and meters was practically killed by the report of the committee that it be referred to the next session of the legislature. The mercantile committee reported "inexpedient" as to granting cities and towns full and absolute control over poles and overhead wires used for the transmission of electricity for all purposes. The committee on manufactures has reported on the order as to the manufacture and sale of electric lights by cities, recommending that it be referred to the next session of the legislature. The street railway committee reported a bill authorizing the Nantucket Electric Street Railway company to do business as a common carrier.

Attorney-General Waterman has been asked by the Massachusetts legislature to give an opinion as to whether or not, under the provisions of the constitution, cities and towns may manufacture and sell gas and electricity. He has already given his opinion in the negative as to their right to do so under existing statutes. The Supreme court of Maine has just given a decision declaring that cities and towns under the constitution have no right to engage in a commercial business of any kind.

The first anniversary of the Thomson Scientific club of Lynn was celebrated last Tuesday evening by a dinner at Exchange Hall, at which about 70 members and guests were present. This club was organized May 13, 1889, and is composed principally of young men employed at the Thomson-Houston Electric company's factory and in the works of the Thomson Electric Welding company. The present officers of the club are E. W. Rice, president; J. E. Randall and O. W. Brooking, vice-presidents; L. T. Robinson, treasurer; A. H. Carsley, secretary; and George F. Curtiss, reviewer. After the dinner, speeches were made by James F. Meech, Prof. Elihu Thomson, C. J. Van Depoele, Dr. F. T. Hazlewood, A. L. Rohrer, J. E. Randall and H. D. Sears. Mr. Meech said that in June Thomson-Houston electric railways would be in operation in Bremen, and in August one would be running in Dresden. He also stated that the total mileage of electric cars on the West End road in Boston for the fourteen months preceding March last was nearly 1,600,000 miles. Prof. Thomson's subject was "Electrical Engineering: The Problems of the Future." He referred to the fact that many problems in electrical engineering are now carefully worked out that only a short time ago were the subject of "systematic" guesses. One of the problems now in hand is the construction of larger dynamos. Now a generator of 100 to 200 or 250 horse power is considered large, but the time will soon come when we may confidently expect the construction of dynamos of 1,000 or 2,000 horse power. An interesting problem in electric railroading is the attainment of higher speeds and the application of larger powers. There is no good reason, he said, why we may not expect to attain, with electric locomotives, a speed of 100 or even 150 miles per hour. The professor referred to the possibilities of electricity as a means of transforming crude materials into food. By chemical processes, he said, charcoal may be transformed into grape sugar, and it is not extravagant to suppose that these chemical processes may be supplanted by electrical. Other problems, such as the production of electricity direct from coal, the production of light without heat, and the more economical distribution of currents for lighting purposes, were also discussed by the professor.

George W. Mansfield of the railway department of the Thomson-Houston Electric company, delivered a lecture upon "Electricity" at Gloucester, Mass., on May 13th, under the auspices of the city Y. M. C. A.

The committee on street railways of the Massachusetts legislature reported a bill on Wednesday of this week granting the West End Street Railway company of Boston the right to construct an elevated railway. The bill provides that the company may operate its cars by the use of electricity, and may carry its electric wires for the operation of its surface or elevated roads upon or over the elevated structures. The bill has not yet passed the legislature.

O. H. M.

THE ELECTRIC MOTOR.

The Belt Line Electric Railway company has been formed at Port Townsend, Wash., capital stock $150,000

"The electric cars were unconscionably slow a-coming, but they are simply greased lightning a-going," is the compliment of the *Evening Wisconsin* to the Milwaukee electric lines.

The city council of Milwaukee will grant the Cream City street railway company the right to extend its lines to the city limits. It is the intention of the company to install an electric system.

The Conpeville, Admiralty Bay & Chicago Railway company has been incorporated for the purpose of building an electric railway from Conpeville to Chicago, Wash. Work will be commenced at once.

The cars on the Fourth avenue electric line, Minneapolis, have ever since the starting of the line been lighted by electricity, but an oil head light has been used. This, however, has been done away with, and an electric light substituted which works to perfection.

A telegram from Joliet, Ill., says: The penitentiary and Oakwood cemetery extensions of the Joliet Electric Street Railway company are completed. All parts of the city are now connected, making the system one of the most extensive and complete in that part of the country.

The electric railway companies of Milwaukee have experienced considerable difficulty in the matter of securing suitable poles for their system. The numerous sharp curves in the road place a great strain on the poles, and the old style of sectional pole was found inadequate. A new style of pole has been tested, and promises to be generally introduced on the lines now in operation. It is made in one piece, and tapers gracefully from the foot to the top. It is made by a Milwaukee concern, and is giving satisfaction in the Cream city.

A St. Louis paper on May 18th says: In answer to a letter from the Mayor of De Soto, Mo., City Counselor Bell yesterday forwarded an opinion that the city of De Soto has the necessary authority to contract for the lighting of its streets with electricity for a period not to exceed twenty years. The city council of De Soto has been considering the plan of using electric lights for street illuminating purposes for some time but has been undecided whether the city has the right under its charter, to make a contract for a long period with an electric lighting company. Counselor Bell's opinion will settle all doubts on that score.

A Minneapolis paper says: The material for the construction of the street railway lines is just commencing to arrive in sufficient quantities. Engineer Cliff Wise says that the tardiness of some of the material in arriving has caused a delay in the progress of the work. Monday work was commenced upon the Washington avenue line at Cedar avenue, and yesterday had progressed as far as Eleventh avenue south, the tracks being widened, and conduits laid all of the way. The conduits used for carrying the feeders consist of a paper tube, impervious to moisture, about three-eighths of an inch in thickness, and $1\frac{1}{2}$ inches in diameter. This tube is in turn laid in a box. Electric motors and broad gauge car trucks are on the way, and as soon as the lines are completed there will be enough broad gauge cars ready to equip them. Work is also in progress upon the tunnel to supply the power house engines with water while the beds upon which immense machines will rest are now being constructed.

Theodore Moss, proprietor of the Star theater, corner of Broadway and Thirteenth street, New York, after considering various plans for cooling the auditorium of the theater during the performances in the summer months, has adopted the plan submitted by the Crocker-Wheeler Electric Motor company of Fourteenth and Washington streets, through Mr. McCoubray, secretary and general sales agent. A trial of the apparatus on Monday, May 12th, in the presence of Mr. Moss and the staff of the theater, demonstrated the complete success of the plant, and the patrons of the theater during the warm weather will find the temperature as pleasant as may be found at Newport, no matter what the temperature may be on the outside. The plant consists of a large Crocker-Wheeler electric motor and an immense pressure blower, an extensive ice chamber, various ducts leading to the auditorium, and numerous registers for controlling the flow of air. One of the peculiarities of the system is the construction of the ice chamber, which is so arranged that the drippings of the water from the ice is utilized to cool the air before it comes in contact with the ice itself. The system is an assured success, and will keep the atmosphere of the theater in a delightful condition, even without the use of ice. It is proposed to use ice only when necessary in extremely hot weather. A volume of 25,000 cubic feet of air per minute at a temperature much lower than the outside air, is forced into the auditorium. It is believed, too, that this is but the foundation of a system by which cool air will be delivered into houses throughout cities and towns. When the several small electric fan motors ordered by Mr. Moss, and which are a part of the system, are placed in position, the plant will be complete as designed by Mr. McCoubray.

THE ELECTRIC LIGHT.

Sonora, Cal., has granted a franchise for electric-lighting.

Arrangements for an electric light plant at Attala, Ala., are being made.

An electric light plant may be installed at Highland, Ala., by the city.

The establishment of an electric light plant at Iron Gate, Va., is contemplated.

Boston capitalists have decided to erect an electric light plant at Chattanooga, Tenn.

An electric light plant is an assured fact at Mt. Sterling, Ky. The contracts have been awarded.

A company is organizing for the erection of an electric light and power station at Lonaconing, Md.

The Citizens' Gas Light company of Jackson, Tenn., will double the capacity of its electric light plant.

The city of Gainesville, Ga., will hold an election to consider the issuing of bonds to purchase the Gainesville electric light plant.

The Carrollton, Ga., Light & Power company, to erect an electric light plant, has been incorporated with a capital stock of $25,000.

The California Electric Light company has just closed its 32d dividend, making $272,000 paid to stockholders since September, 1886.

The Thomson-Houston company will install a plant at Napa, Cal. The franchise of the Napa Electric Light company has been repealed.

All the preliminaries for the Edison incandescent light plant at Bainbridge, Ga., have been completed. The contract has been awarded to the United Edison Manufacturing company.

The Los Angeles, Cal., Electric company has contracted with the Westinghouse company to put in two 750 light incandescent machines. This is the beginning of the incandescent system for that city.

The Bonham Electric Light company have placed an order with Clower & Harris, Dallas, Tex., for a 300 light Heisler dynamo. The company says the Heisler system is giving satisfaction and this increase is a substantial corroboration of its assurance.

The Electric Light company of Los Angeles, Cal., recently changed management. W. B. Cline is president; W. R. Blackman, secretary; Jas. Warren, superintendent. The company will put in a 1,500 light incandescent plant, new boilers, etc., at a cost of about $15,000.

Mayor Noonan of St. Louis has ordered the tops of gas lamps in the streets of St. Louis removed, and the whole town is in confusion. It is said that many men who have lived in the city for years have been unable to find their homes owing to the fact that no provision was made for placing labels on the corners when the lamps were removed.

A dispatch from Merrill, Wis., says: The Merrill Railway & Lighting company has decided to place electric cars on the new street railway to be built in this city, and has let the contract for furnishing the electrical apparatus to the Westinghouse Electric company. M. K. Goehnauer of Appleton, to whom the contract was let for constructing the road, begins the distribution of material at once. The railway will be ready for operation in seventy days.

At a recent meeting in New York city, the National Board of Fire Underwriters had a discussion on the question of electric lighting. A committee, headed by Vice-President John H. Washburn of the Home Life-Insurance company of that city, discussed the various methods of lighting and heating now in use. In response to an invitation from the National Electric Light association, the board appointed W. A. Anderson, Superintendent of the Fire Survey of the New York Board of Fire Underwriters, to act in its behalf in a National Electric Insurance company.

A Cincinnati paper says: There will be a great deal of interest in the condition of electrical affairs in this town before the snow falls again. The Cincinnati Electric Light company, despite its recent deals with rival competitors, will have all the competition it wants before long. The Cincinnati Electric Light & Power company, a corporation with a capital stock of $1,000,000, does not seem to have been organized for merely ornamental purposes. It has advertised for bids for the construction of a plant, which looks very much like business. It has secured the right to lay conduits in the streets, and this is a valuable franchise. It is denied with emphasis that the company wishes to dispose of this right at a large, round sum of money.

At a recent meeting of the Oakland City street light committee the plan for lighting the city for the ensuing year was discussed. A representative of the Electric Light & Motor company said that at an expenditure of $10,000 additional to the appropriation for gas and electric light the city could be lighted by electricity with thirty times greater radiance. The Gas, Light & Heat company considered that to light the city with electric lights according to the ideas of the city electrician would cost from $25,000 to $30,000 more. He thought it would take 450 lights to properly light the city by this system. The lighting of the city last year cost about $31,000. To change the present combination system to an electric light system would run the cost up to in the neighborhood of $80,000 in his estimation. It was decided to ask for bids for lighting the city by gas, electricity and a combination of gas and electricity similar to the system at present in vogue.

Miscellaneous Notes.

The Electrical Engineering company has been organized at San Francisco.

The Sacramento Electric Construction company has been formed to do a general electrical construction business.

The Bonanza Mining company of Batesville, Ark., announces its intention of erecting a 20 ton electric concentrating plant.

The Rhodes & Keese Electric company has been formed at Los Angeles, Cal.: S. J. Keese, President; W. I. Keese, secretary; I. H. Rhodes, vice-president.

Platinum is going up alarmingly, says the New York *Herald*. That metal so essential and well nigh indispensable to certain mechanical arts has risen 100 per cent. in value within the last year, and there is every prospect that it will continue to ascend in the market. No reason seems to exist for supposing it will ever go down again. To-day platinum costs $11.50 a troy ounce. It is destined in all probability never again to be cheaper—a precious metal truly! This news is of most serious importance to electricians.

Business Mention.

The Westinghouse Electric company has just issued a remarkably handsome catalogue, descriptive of its new alternating current arc light system. It is profusely illustrated, and its typographical appearance is strikingly attractive.

The exhibition of the Brown Electric Protector company at Builders' Exchange, Philadelphia, May 10, was in every way a complete success, and demonstrated the perfect protection to all kinds of electrical instruments which is needed. The company is already doing a handsome business.

The Ashton Valve company, Boston, reports a flourishing business, and has not missed paying a dividend quarterly in many years. The company will equip the new government cruiser, the Maine, with valves. It is equipping several of the Brazilian government cruisers. It is adding to its works new machinery, and an extra number of machinists are necessary to keep up with orders.

Julius Andrae of Milwaukee, is one of the pioneer electricians of the west and is to-day in the rapid increase of the electrical business, reaping the reward of his early exertions. At his store, 225 West 2d street, is carried one of the largest and most complete stocks of electrical supplies in the west. He also makes a specialty of contracting for all kinds of electrical work from installing an electric bell to an entire electric light plant. Mr Andrae is the Milwaukee agent of the Mather Electric company and has made a number of important installations of this excellent system in that city. His factory is located at 186 2d street where large quantities of electrical supplies are manufactured.

The Ball Engine company of Erie, Pa., has the following orders for their special vertical engines adapted for electric lighting on shipboard: Four vertical compound engines for the United States gun boats, Concord and Bennington, ordered by the United Edison company; one vertical compound engine for New York Life Insurance company of Minneapolis, Minn., ordered by the Brush Electric company; one vertical compound for new steamer for the Brazilian Steamship company, ordered by the Complete Construction company of New York; two vertical double engines ordered by the Brush Electric company for the United States steamship Miantonomoh; two vertical compound engines, ordered by United Edison company for steamship Plymouth of Old Colony Steamship company.

It is interesting to notice that Queen & Co., the well known makers of electric test instruments of Philadelphia have apparently outgrown their surroundings, and are building up a wonderful business. Until within the last two or three years practically all the measuring apparatus used in this country was imported, a popular feeling existing that the value of an instrument was enhanced if a foreign name appeared on it. Such is not the case now. Queen & Company have demonstrated that they can make electrical test instruments at least equal in quality to the best of foreign make, and as reasonable in price. They are finding customers for their standard resistance boxes, portable testing sets, ammeters and voltmeters and their other specialties, in all parts of the United States and have even had inquiries from abroad. They report a recent large sale in the Northwest comprising Ayrton & Perry instruments, portable testing sets, Cardew voltmeters, tachometers, etc., to the amount of about $1,500. This is a sample of the demand for their apparatus. A new and enlarged edition of their catalogue is in the printer's hands now. It will pay all who desire a copy to correspond with them.

Electrical Patents.

Issued May 13, 1890.

427,534. Stopping Mechanism for Knitting Machines. James T. Ashworth, Bristol, Conn.

427,540. Lightning Arrester. Louis Bell, Lafayette, Ind.

427,541. System of Electrical Distribution. Louis Bell, Lafayette, Ind.

The invention consists in the combination with a distributing conductor divided into sections with current limiting devices between each section, of an independent connection between each section and the source of supply, with a current limiting device in each of said connections.

427,545. Fuse Block. Charles F. Brush, Cleveland, O.

The invention relates to an improvement in safety fuses for electric systems of distribution, the improvement being specially applicable to electric railway systems.

427,549. Electric Prod-Pole. John M. Burton, Wichita, Kan.

427,569. Trolley Arm for Electric Cars. William F. Harriman, Des Moines, Ia.

Claim two follows:

"The combination, with an electric car, of an arm horizontally pivoted upon the top thereof, an inclined trolley arm supported thereon, and a trolley connected to the said trolley arm by a swivel joint."

427,571. Alternating Current Apparatus. Edward Heymann and Frank W. Heymann, Boston.

427,574. Electric Heater. Benjamin C. Howard, Baltimore, Md

427,589. Guide for Trolley Wheels. Henry A. Marks, Lynn, Mass.

427,606. Electro Magnet. Francis J. Patten, New York, N. Y

The invention consists of two contiguously coiled strands of wire, one of which conveys only positive currents, and the other only negative currents, but in such direction as to produce the same magnetizing effect within the coils.

427,621. Multiple Switch-Board Test System. Charles E. Scribner, Chicago, Ill.

The invention consists in the construction of the terminal plugs of the flexible cords and in the connections between the cords and the operator's telephone.

427,622. Switch-Board. Charles E Scribner, Chicago, Ill.

The invention consists in making the tubular frame of the spring jack switch in two parts, the front portion consisting of a hollow screw and the rear portion being tapped out to correspond with the thread upon the hollow screw.

427,623. Test Circuit for Multiple Switch-Boards. Chas. E. Scribner, Chicago, Ill.

The invention consists in testing apparatus placed at the different switch-boards, and the telephone line circuits and switching apparatus combined with a battery in such manner that on making a test, circuit will be closed from the battery through a telephone if the line tested is free.

427,624. Multiple Switch-Board Test Circuit. Charles E. Scribner, Chicago, Ill.

427,628. Trolley or Collector Wheel for Electric Railways. Sidney H. Short, Cleveland, O.

The first claim is given:

"A trolley or collector wheel of carbon."

427,674. Carbon Brush for Motors. Leo Daft, Plainfield, N. J.

Claim one reads as follows:

"A brush or contact maker for carrying an electric current to a surface moving thereunder, consisting of non-lubricating carbon and plumbago."

427,681. Electric Matrix Machine. George A. Gnodson, Minneapolis, Minn.

427,710. Composition for Supports for Secondary Battery Electrodes. Walter F. Smith, Philadelphia, Pa.

427,611. Fire Alarm Regulator. Clarence J. Spike and Hedley V. McLeod, Halifax, Nova Scotia.

427,724. Automatic Electric Cut-Out. Edward M. Bentley, New York, N. Y.

427,725. Electric Railway. Edward M. Bentley, New York, N. Y.

427,726. Contact Device for Electric Railways. Edward M. Bentley, New York, N. Y.

The invention comprises an upright piece pivoted to the top of the vehicle and provided at its upper end with a transverse contact piece of a length sufficient to make connection with the wire at any point along the range of transverse movement of the vehicle relatively to the wire.

427,742. Telephone Exchange Apparatus. John J. Carty, New York, N. Y.

The invention includes a subscriber's station provided with a generator and switching devices, in combination with a branch from the center of the resistance of said line at the central office through an annunciator to ground, whereby the subscriber may bring his generator into a grounded circuit, including said annunciator.

427,746. Electrical Conductor for the Transmission of Power. William J. Cordley, Richmond, Va.

427,748. Electric Meter. Stanley C. C. Currie, Philadelphia, Pa.

427,749. Method of Measuring and Registering Electric Energy. Stanley C. C. Currie, Philadelphia, Pa.

427,751. Electrical Converter. Sebastian Z. de Ferranti, Hampstead, County of Middlesex, Eng.

The last claim is:

"6. The combination, with a converter having primary and secondary coils, and a soft iron core within the coils, and also extending around them, of a metal case with separate compartments provided upon it containing the connections of the primary and secondary circuits respectively."

427,762. Electric Signal. Josef Haas, Jr., Vienna, Austria-Hungary.

427,781. Electro Pneumatic Clock System. Carl A. Mahrhofer, Berlin, Germany.

427,783. Electric Circuit Closer for Railway Signals. Frank E. Morgan and Frederic A. Lane, New Haven, Conn.

427,785. Secondary Battery Electrode. James F. McLaughlin, Philadelphia, Pa.

427,789. Secondary Battery. Thomas F. Nevins, Brooklyn, N. Y.

427,823. Fuse Plug. William A. Anthony, Hartford, Conn.

427,873. Bilge Water Alarm. James W. Jones, New York, N. Y.

427,876. Telegraph Key. John S. Kaylor, Bismarck, Ill.

427,878. Guard and Stay for Electric Railway Wires. Conrad J. Kilian, Milwaukee, Wis.

The invention consists, essentially, of a guard wire stretched over the transmission wire, of depending wires connecting the same with the transmission wire at suitable intervals, of guard wires stretched parallel with the transmission wires at one side thereof, so as to prevent broken wires falling across the same, from coming in contact with the transmission wires.

427,879. Electric Indicator. Frederic A. Lane, New Haven, Conn.

427,917. Multiple Switch-Board. Charles E. Scribner, Chicago, Ill.

427,951. Incandescent Electric Light Bulb. Thomas B. Atterbury, Pittsburg, Pa.

427,953. Electric Train Signaling Apparatus for Railways Eugene J. J. de Baillehache, Paris, France.

427,971. Method of Electric Welding. Charles L. Coffin, Detroit, Mich.

The process consists in placing the parts to be welded in close proximity to a voltaic arc, protecting the arc and the parts to be welded by a jacket of non-conducting refractory material, and after sufficiently heating the parts, pressing them together to complete the weld.

427,974. Means for Effecting Communication in Telephone Systems. Louis J. Crossley and Walter Emmott, Halifax, and John F. Harrison, Bradford, County of York, Eng.

The main object of the invention is to provide means whereby a person desirous of using a telephone on a telephonic system can effect communication with the central office or exchange only by first depositing into a suitable receptacle a coin or equivalent circular disk-like device, representing a monetary value equal to the toll or charge for the use of the telephone.

427,978. Alternatiog Current Motor. Michael von Dolivo-Dobrowolsky, Berlin, Germany.

The claim reads:

"In an alternating current motor, the combination, with a field magnet, of an armature composed of an iron body of rotation, bars, strips, or wires of copper arranged transversely to the direction of rotation of the motor, and also transversely to the lines of force of the magnetic field, and copper conductors, whereby the said bars, strips or wires are connected together at both ends."

427,984. Automatic Lightning Arrester. Claude M. Griffin, Kansas City, Kan.

427,986. Lantern for Electric Arc Lights. John W. Gwynn, Bucyrus, O.

428,008. Arc Lamp. Philip Lange, Pittsburg, Pa.

Of the ten claims we give the last:

"The combination, with an electric arc lamp mechanism, of carbon electrodes for the lamp placed in the same perpendicular plane and having extended confronting edges, and a generator of rapidly-alternating electric currents having its terminals connected with the respective electrodes."

428,026. Process of Shrinking and Fulling Felt by Electricity. Francis C. Taylor, Danbury, Conn., and John R Hard, New York, N. Y.

428,030. Electrical Target Trap. James Wolstencroft and William H. Soley, Philadelphia, Pa.

428,038. Commutator Brush. Evan H. Bowen, Akron, Ohio.

428,041. Track Instrument for Railroad Signals. Marlon S. Conly, Hyde Park, Ill.

428,042. Method of Producing Alternating Electric Currents. Marlon S. Conly, Hyde Park, Ill.

The method consists in first closing a local battery circuit in which is included a helix, thereby causing the helix to become electrostatically saturated, and then simultaneously opening the local circuit and introducing the line circuit therein, alternately reversing the terminals of the local with the terminals of the line circuit after each closing of the local circuit, whereby the electrostatic discharge from the helix will traverse the line circuit in alternately opposite directions.

428,046. Terminal for Electric Cables. Joseph A. Hanagin, Chicago, Ill.

The invention is designed more especially for single conductor cables, as, for example, those used in arc lighting and designed to carry currents of high tension. The invention consists in placing a metallic cap over each of the ends of the sections of the cable to be united, soldering the conductor to these caps, and then locking the caps together.

428,050. Ground Detector. Charles H. Macloskie, Allegheny, Pa.

Claim five follows:

"The combination, in an electric distribution system, of a main generator, a line conductor having a temporary ground, an artificial ground, and an interrupter connecting the faultless conductor alternately with the faulty conductor, and the artificial ground."

428,055. Manufacture of Telegraph Cables. William R. Patterson, Chicago, Ill.

The invention consists in placing the core of insulated conductors, deprived of moisture, within the pipe, and then forcing insulating filling into both ends of the pipe.

428,057. Pyromagneto Electric Generator. Nicola Tesla, New York, N. Y.

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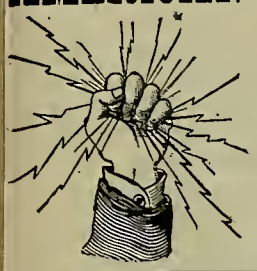

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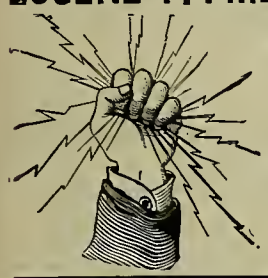

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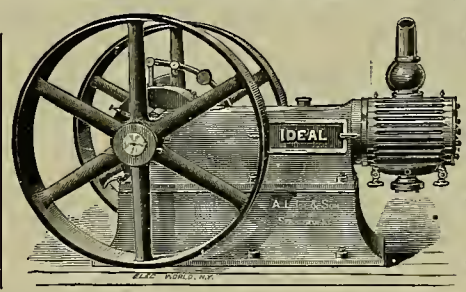

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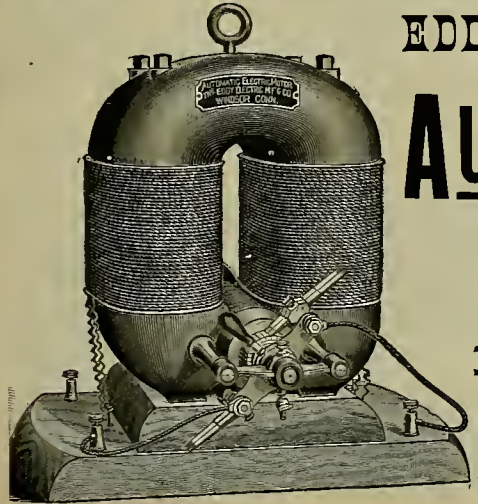

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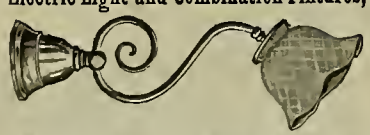

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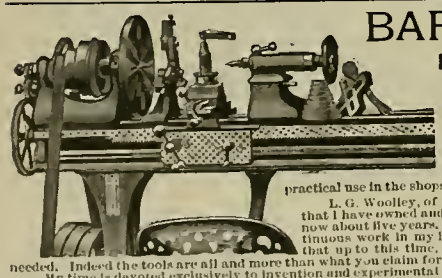

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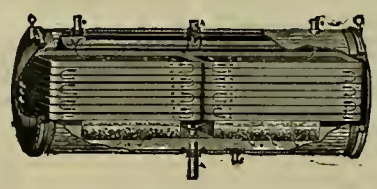

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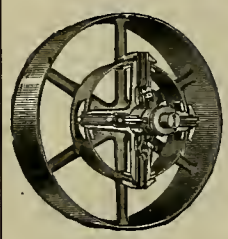

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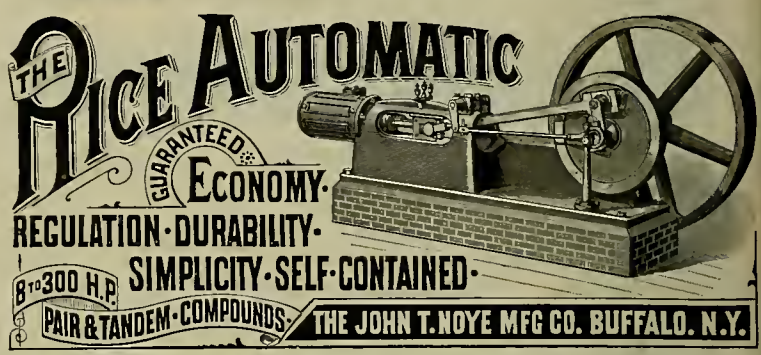

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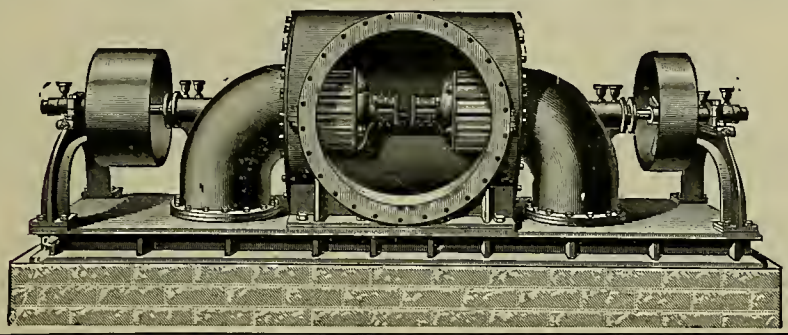

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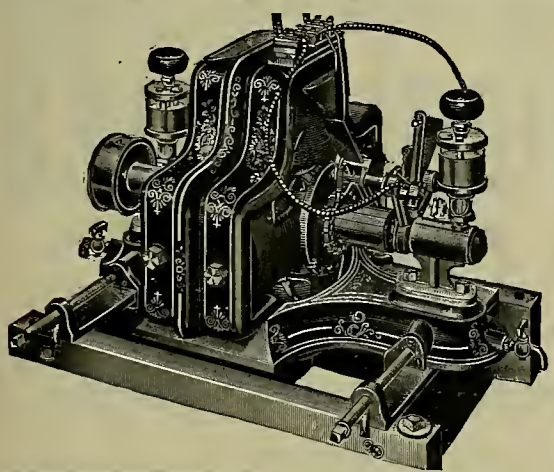

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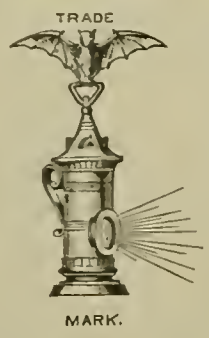

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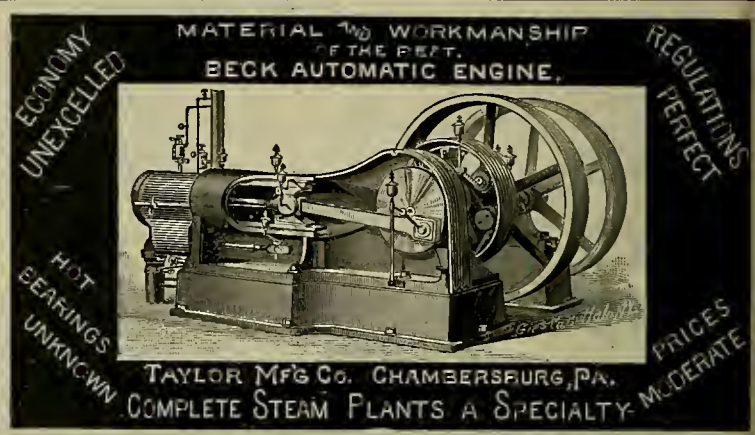

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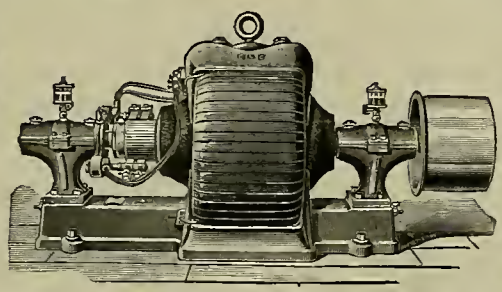

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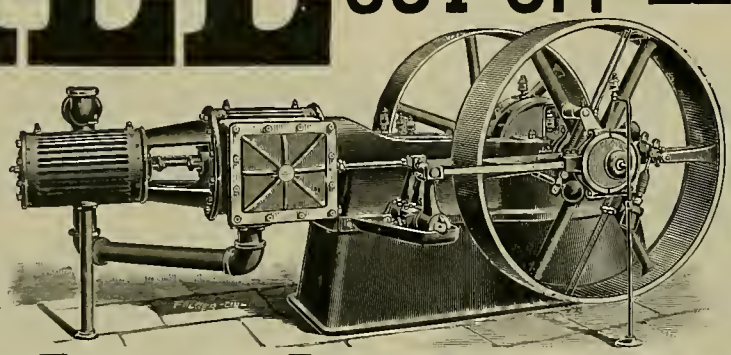

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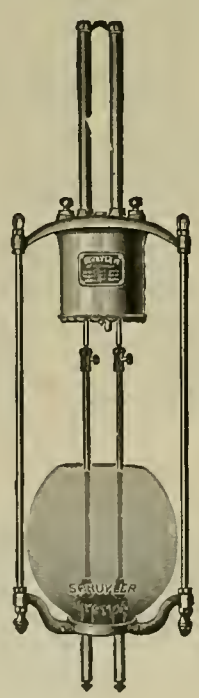

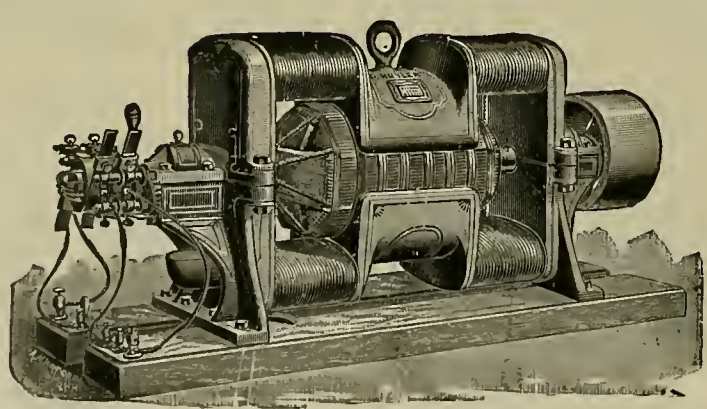

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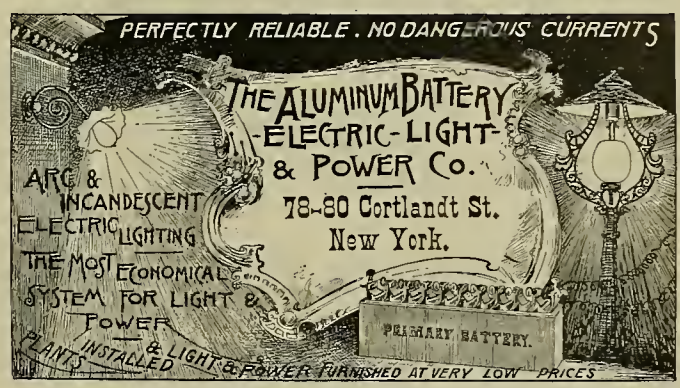

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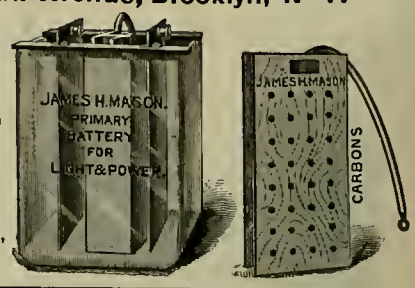

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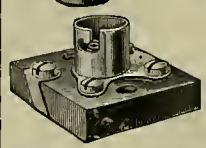

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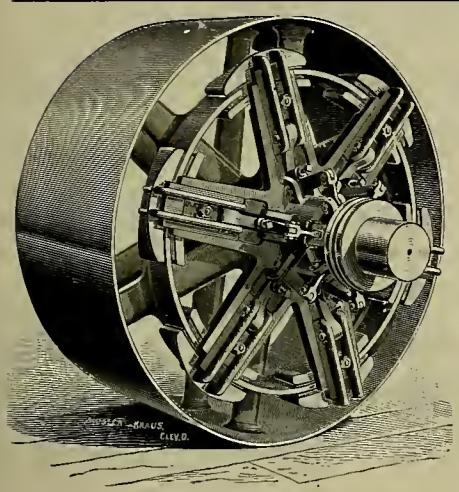

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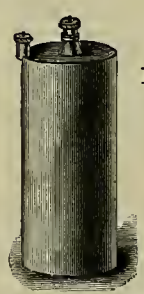

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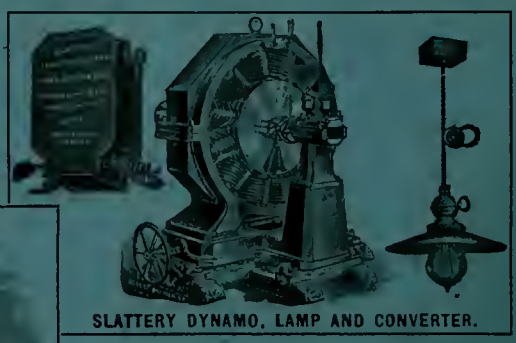

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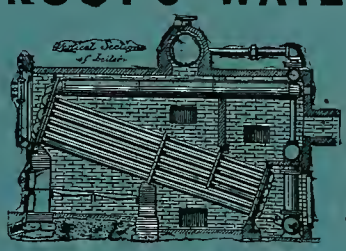

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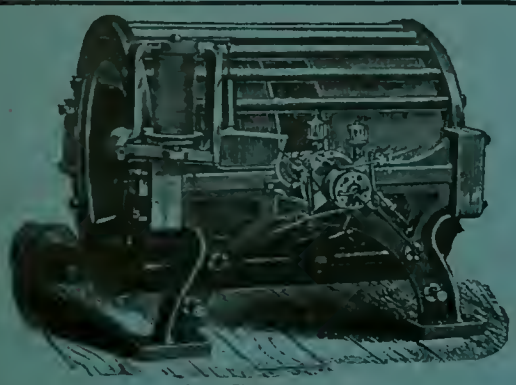

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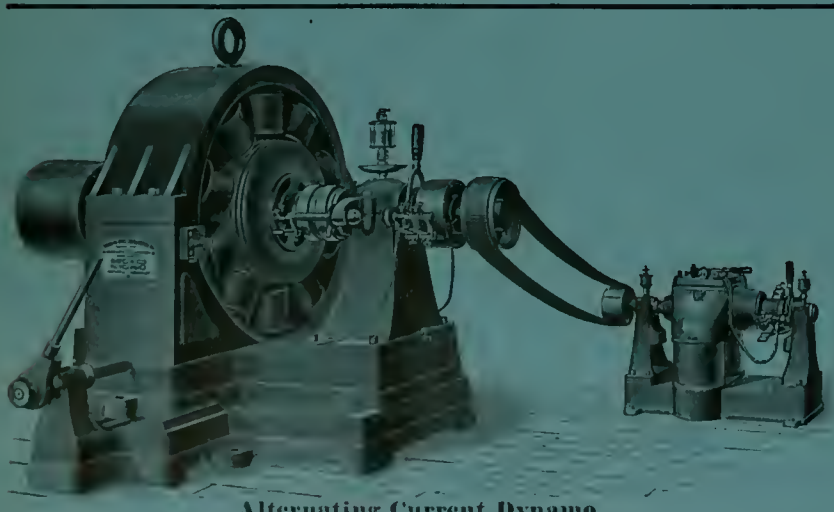

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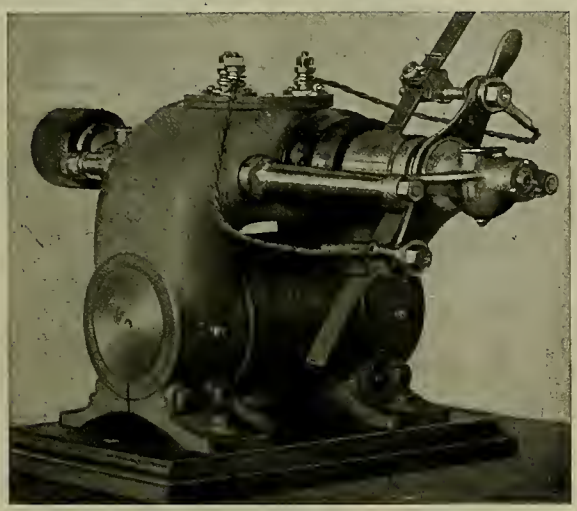

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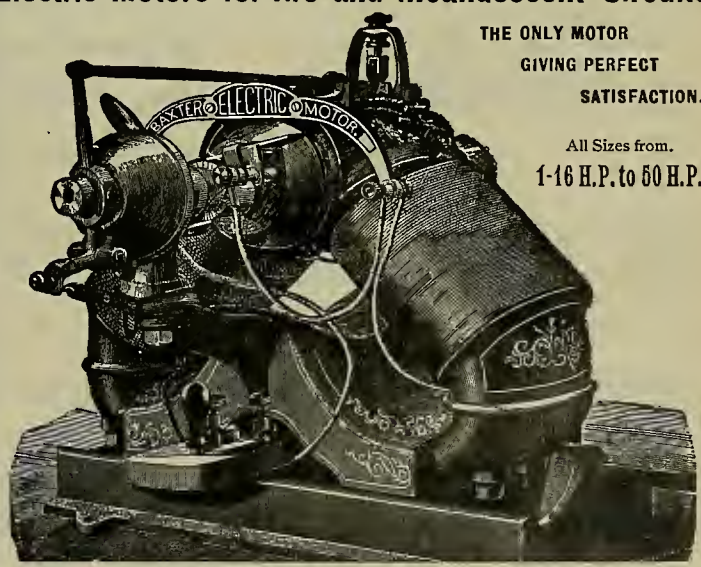

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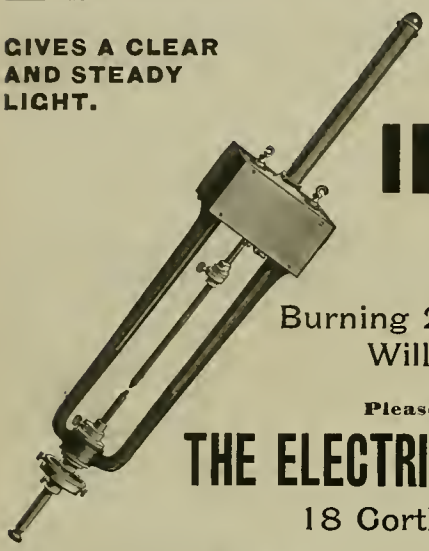

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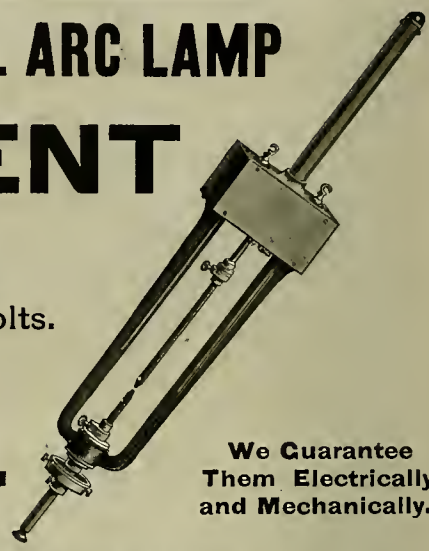

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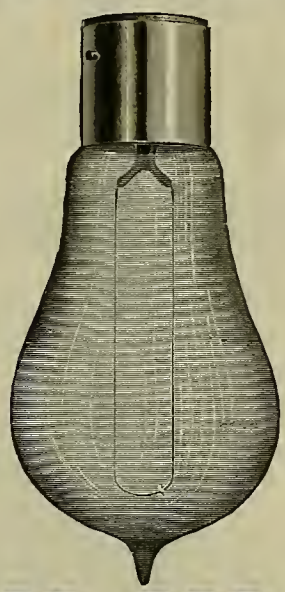

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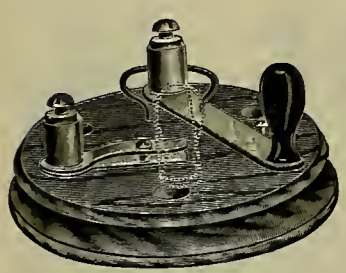

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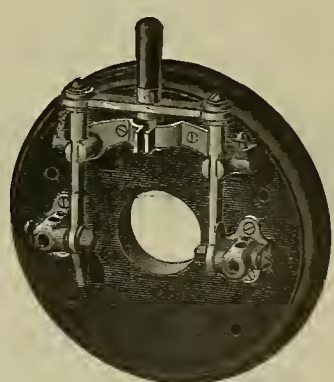

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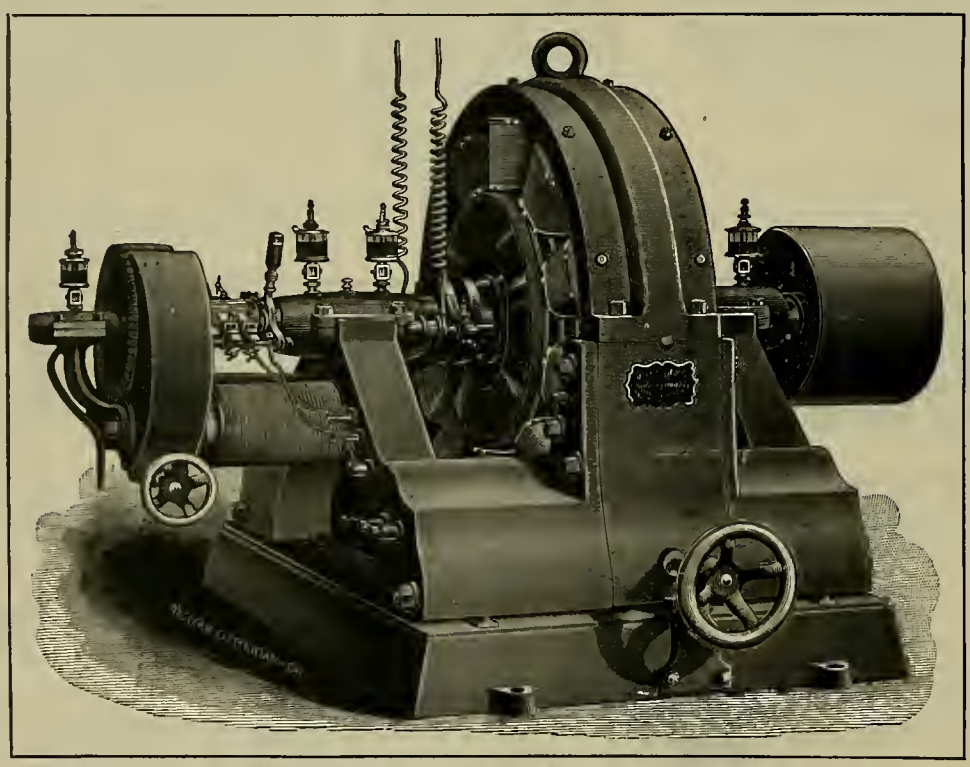

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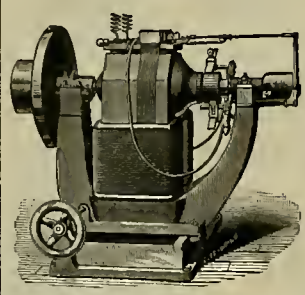

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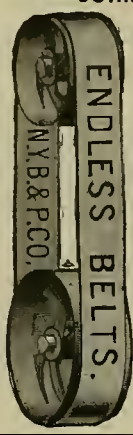

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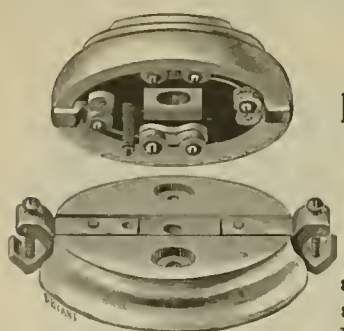

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Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, MAY 31, 1890. No. 22

Electric Railway at East Saginaw, Mich.

The street railway at East Saginaw, Mich., one of the leading points in the lumber and salt industries of Michigan and one of the most progressive cities in the state, has recently been equipped by the Detroit Electrical Works with the Rae system of electrical propulsion. This road was originally owned by a company known as the East Saginaw Street Railway company. which, after completing its lines in East Saginaw, built across the bridge into Saginaw City. The company was subsequently incorporated under the name of the Union Saginaw Street Railway company. Jacob Seligman of East Saginaw controlled the corporation and after securing new franchises in both towns, built an extension. The road as extended by him included seventeen and three-fourths miles of track. About the first of August, 1889, Mr. Seligman sold the road to a number of Detroit gentlemen, among whom were W. A. Jackson, Frank E. Snow, W. H. Stephens and others. They obtained a new franchise from the cities of East Saginaw and Saginaw which since that time have consolidated into the single city of Saginaw. They put in the overhead electric system under the patents of Frank B. Rae of Detroit. A considerable part of the road was rebuilt and, the entire track was changed to standard gauge, and a double track was built on Washington Avenue from the barns near Bristol street, where the road branched to Saginaw City. The wooden poles which were used were placed 125 feet apart on the side of the streets except in the business portion of the towns where the cross supporting wires are fastened to the sides of the buildings by a patent key. The trolley wire is 18 feet above the ground except at the railroad crossings where the height is 24 feet. Although the road has been in operation in East Saginaw since about the first of the year, the progress across the river has been retarded by a number of suits with persons owning property along the line who tried to enjoin the company from operating the road under various charges that an electrical road was dangerous to life and property. As stated in the Western Electrician of April 19th these suits were recently decided in favor of the company, and have been appealed by the defendants. The opposition is said to come chiefly from a rival horse-car line which is said to be paying the expenses of litigation. As a matter of fact the people generally in both towns are perfectly satisfied with the road, and believe that a new era has come in the history of their town since rapid transit has appeared.

The company formerly paid $600 a year for the privilege of crossing a toll bridge leading into that part of the present city which was known as Saginaw before the consolidation. When the electric system was adopted the bridge company, for what it considered sufficient reasons, refused to allow motor cars to cross the structure although, it is said, several thousand dollars per annum were offered for the privilege. This refusal necessitated the purchase of the bridge by the railroad company, which completed the deal about a month ago. The bridge is now being put in shape for the use of the motor cars.

A view of the power house is given in Fig. 1. The building is located near the corner of Washington Avenue and Whipple street. It is a substantial brick building; it is light and airy and was erected especially as the central station. The electric power is supplied by four 65,000 watt Rae generators of the type described in the Western Electrician of May 3d. The engine at present supplying the power was manufactured by A. F. Bartlett & Co. of East Saginaw; it is soon to be replaced by a 300 horse power Corliss, built by the same firm. As soon as this new engine is in place a power circuit will be extended throughout the main part of the city. A large demand is anticipated for motors for all kinds of work.

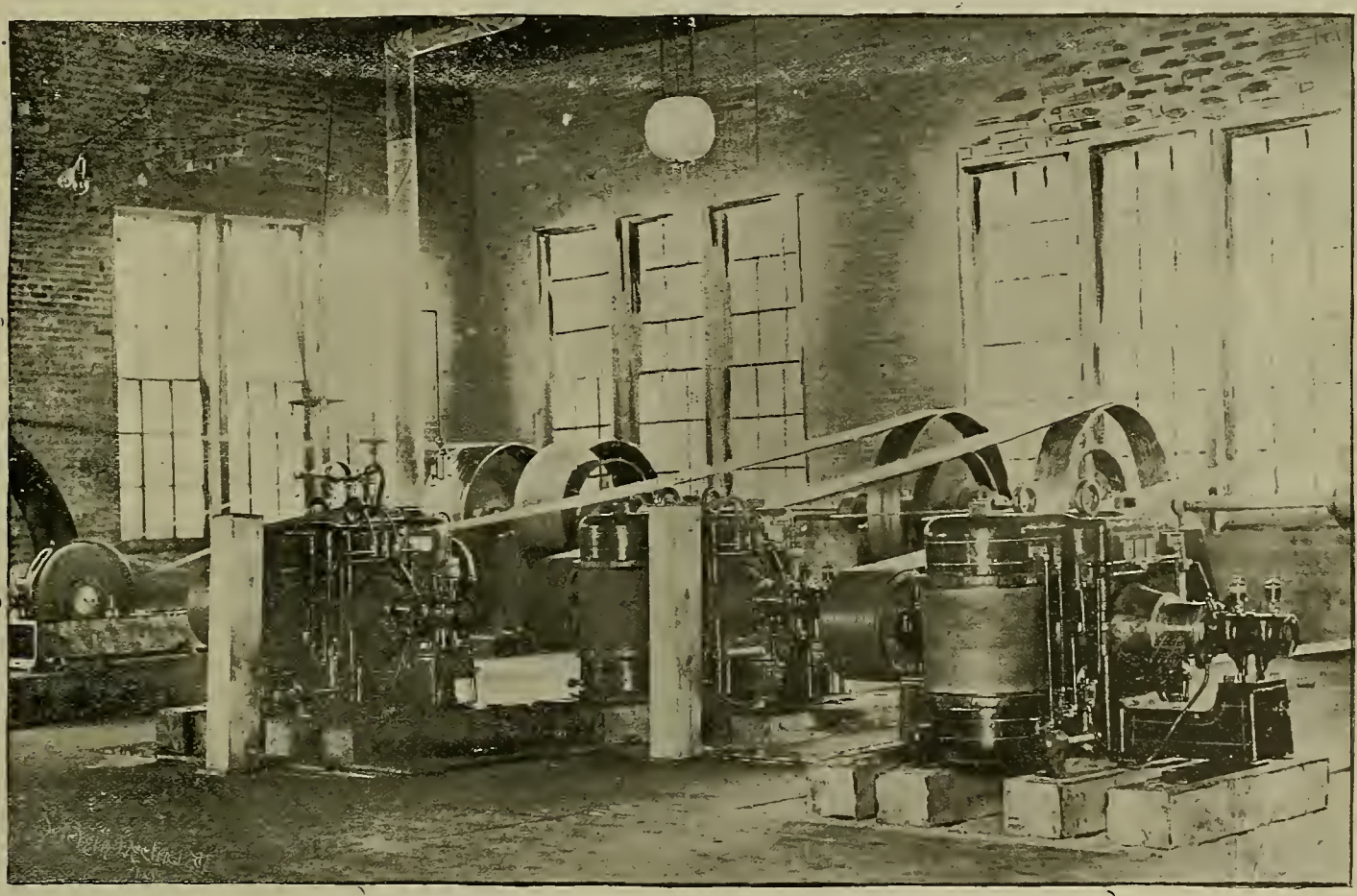


FIG. 1. ELECTRIC RAILWAY AT EAST SAGINAW, MICH.

The special features of the Rae system of electric traction are a single motor of large power attached to a rigid frame support, a disposition which secures, it is claimed, perfect alignment and freedom from noise. The single motor is attached to both car axles. All the bearings are dust proof and friction is reduced to a minimum. The speed regulation is of extreme simplicity, and the controlling apparatus occupies no useful space on the car platform since a single lever controls the movement in either direction, from either end of the car.

Fig. 2 represents a street scene on the Sagi-

naw Union street railway on Washington avenue, near Whipple street. The line construction is shown, and the trolley fixture as well as the supporting spring holding the trolley pole in place. The trucks used on the line, as shown in the car, are of the Manier type. The cars were made at the Detroit shops of the Pullman company, and are very comfortable and serviceable.

FIG. 2. ELECTRIC RAILWAY AT EAST SAGINAW, MICH.

While the road has always proved a paying investment, a large increase in earnings followed the equipment of several cars with electric motors. At first several horse cars remained on the road but the receipts of the motor cars more than doubled those of the former, although their earnings were not reduced by the change.

At present the entire line is operated by the electric motors, and the increase in the receipts and the decrease in the expenses are very gratifying to the owners. In a short time the entire line through Saginaw City will be in operation. It is believed that the popularity of the line will soon necessitate a very large increase in the rolling stock. Although the electrical equipment has been in operation since early in December, there has not been a single instance when delay from any breakage of the electrical apparatus has occurred, and almost the entire number of cars have run continually since they were placed on the line.

Electrical Executions Constitutional.

The argument in the Kemmler case was heard by the Supreme Court of the United States at Washington, May 20th. Roger M. Sherman, in his application for a writ of error, made an elaborate argument contending that the statute was unconstitutional. He persisted that Kemmler was liable to suffer the most exquisite torture under the proposed method. Mr. Sherman followed this up by declaring that it was proposed to give this man up to a lot of young experimenters whose knowledge was within very narrow bounds. He ridiculed the methods proposed by the state of putting wet sponges about the points impinged by the wires, and said that the sponges and all, it was shown, would be burned up. He spoke of how the state had proposed to rectify this defect by having a man play a stream of water upon the sponges until one day a fireman received a severe shock at the burning of an electrical apparatus works by the current passing down the stream of water and felling him to the ground. His object was to show the lack of certainty in the proposed method of killing. He called attention to other features of the law which, he contended, were opposed to the constitution. Attorney-General Tabor of New York, opposed the motion, and defended the constitutionality of the act.

The Supreme Court refused to grant the writ, and Chief Justice Fuller, who delivered the opinion, said: "The change in form of death was within the legitimate sphere of the legislative power of the state. The court cannot see that the prisoner has been deprived of due process of law. In order to reverse the judgment this court should be compelled to hold that the Court of Appeals had deprived the prisoner of his constitutional rights. The court has no hesitation in saying it cannot do this."

Boston feels rebellious over the proposed limit of seven miles an hour for its electric street car speed. "We soon learn to adjust our actions to new conditions," says the *Herald*, "and probably in a short time it would be found that the loss of life or injury to persons due to the running of high speed electric cars was no greater than those experienced under past conditions."

Public Lighting In Chicago.

Comptroller Onahan, Chicago, makes the following statement in his annual report of the city's finances: "An important reduction in price of street lighting was obtained from the gas companies during the year, by which a practical saving of nearly $100,000 per annum has been effected, and at the same time a reduction in the price of gas to the general public in the annexed districts was secured, as shown in my previous report to the city council on the subject. The extension of electric lighting for street purposes north and west may be noted, and the assurances can be given that the South side will soon share largely in the advantage of the city electric light plant and system. It is believed that private consumers can be supplied by the city, and thereby reduce materially the general cost of the public street lighting. According to the opinion of the law department, the expense of lighting the parks and boulevards, heretofore paid by the city, is legally chargeable to the respective park boards. This subject has been brought to the attention of the proper authorities, and no doubt a satisfactory adjustment will be reached."

Dallas Rapid Transit Railway.

The state of Texas has now two electric railways in operation on the Sprague electric system, and others are in course of construction. One of the roads in operation is the Dallas Rapid Transit Railway, a view of which is shown in the accompanying cut. The motive power for operating the cars on this railway was formerly furnished by a steam dummy, which has now been abandoned for the more modern power. The view shows one of the electric cars drawing the old steam dummy. The engraving was made from an instantaneous photograph, and shows the ex-engineer of the steam engine trying in vain to catch the train, which is going so rapidly that he is left behind.

An interesting circumstance in connection with the view, which shows very clearly the easy manipulation of the electric car, is the fact that the motor car is being operated by a young lady who is in charge of the controlling switch, while another young lady is acting as conductor. By way of comparison it might be mentioned that the steam dummy required an engineer and fireman to run it, besides a conductor on the train. The electric road has proved very popular in Dallas and has carried a large number of passengers since its installation. The method of overhead construction used is the single bracket as shown in the illustration.

DALLAS RAPID TRANSIT RAILWAY.

Western capitalists have determined to construct an electric road at Greenville, S. C.

ANNUAL AND GENERAL

Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers was held at the House of the American Society of Civil Engineers, 127 East Twenty-third street, New York, May 20. The annual report of the council was submitted, showing an increase of membership of over one hundred during the last year The increased receipts of the year were $1,260.94, and increased expenses $855.08. The treasurer's report showed a balance in the treasury of $249.24. The officers elected for the ensuing year were as follows: President, W. A. Anthony of Manchester, Conn.; vice-presidents, Francis B. Crocker, Frank J. Sprague and Joseph Wetzler of New York; managers, P B. Delany of South Orange, N. J., Horatio A. Foster and J. C Chamberlain of New York; treasurer, George M. Phelps; secretary, Ralph W. Pope The other members of the council who hold over in accordance with the rules are: Vice-presidents, Edward Weston of Newark, N. J., Dr. Edward L. Nichols of Ithaca, N. Y.; managers, Charles Cutriss and George B. Prescott, Jr., of New York, Thomas D. Lockwood of Boston, William Maver Jr., and Dr. F. Benedict Herzog of New York, Dr. William E. Geyer of Hoboken, N. J., and H. C. Townsend of New York. The vacancies caused by the death of Major Otho E. Michaelis, vice-president, and the resignation of Henry Van Hoevenbergh, manager, will be filled by council.

The total membership of the institute is now 427, to which twelve were added at the last council meeting. About June 1 the offices of the institute will be removed from 5 Beekman to No. 12 West Thirty-first street, the house recently purchased by the American Society of Mechanical Engineers. An arrangement for the joint occupancy of library and auditorium, with separate offices for the secretaries, will, it is thought, be found very desirable to the members of both societies. The following paper was read:

Electricity in the Navy.

BY GILBERT WILKES, U. S. N.

I have taken as my title "Electricity in the Navy," and shall give in my paper the general conclusions derived from five years' more or less intimate connection with the application of electricity in our naval service.

The electrical engineer has little to do with the placing of the dynamo room, which is of necessity governed by the arrangement of the ship as a fighting machine. I shall, therefore, merely consider the power and apparatus of the plant, commencing with the engines.

Both in this country and abroad, compound condensing engines have been used, some having separate condensers, some exhausting into the main condensers of the ship, but the preference seems to be in favor of simple double-acting high-speed engines, the reason being that the power used for electrical purposes is so small in proportion to that of the main engines of the ship, only about an average of one per cent. that the saving does not pay for the additional complication and cost However, with a given plant, the engine should be constructed to allow little variation of speed under large changes of steam pressure, in order to take advantage of the main condenser when possible.

In our service, both horizontal and vertical engines are now in use, the preference in some cases being the result of the shape of the available space. No data have yet been obtained as to the most economical type, but both are doing good service, the mishaps having been due to accidents. Of late years all of the engines put in for electric lighting have been high-speed, the largest of about twenty-five horse power, and running at 400 revolutions. The important points in the consideration of a marine dynamo are:

First—It should be direct driven. The reasons are obvious as, not only is the space taken up by the belting valuable, but in a sea way the danger of running belts must be considered, especially when it is taken into account that naval vessels are fighting machines and the possibility of accidents must be reduced to a minimum.

Second—It should be compact. This is a natural extension of the above. Even now it is difficult to find room for all of the machinery, stores and ammunition, besides providing room for berthing the crew on a modern man-of-war.

Third—It should be free from liability to injury by salt water, and not too subject to mechanical damage. In this respect there remains room for considerable improvement, the latest dynamo now better filling this requirement than did the old "L" machine on the Trenton in 1883, the first dynamo afloat in our navy and which ended its useful career in the great storm at Samoa last year, when it ran until the water had put out the fires under the boilers. On board ship, salt water and damp air get everywhere, and within the last year a number of cases of slight burn-outs have occurred in armatures, which, when installed, measured high in the hundreds of thousands of ohms' insulation. The dynamo should not be easily harmed. The dynamo room is now always low down in the ship, under the protective deck (if there is one), and when the light is not in use, the room is very dark, rendering careful inspection difficult.

Fourth—The dynamo should have small effect on the compasses. This point has received little attention though it is a matter of great importance, as the effect on many vessels is so large that, in order to work up the day's run, it is necessary to know the hours during which the dynamos have been in operation. Complete deviation tables are therefore necessary for the two cases. In different types of dynamos the effect with a twenty-horse power machine, at a distance of twelve feet, will vary from less than one-twentieth of the horizontal component of the earth's magnetism, to several times the strength of the horizontal component. The latter is, unfortunately, rather the rule than the exception, and in consequence, the position of the dynamo room has to be well borne in mind in locating the standard compass.

Fifth—It should be easy in running and require but little attention. The machine should be non-sparking, under constant load, and be able to stand sudden large changes of load with little sparking. This is necessitated by the fact that the dynamos now supplied for incandescent lighting are also used for search light work, and the conditions are aggravated by most of the search lights having hand regulators only. Thus, with a 200-ampere machine, not only are from 50 to 100 amperes thrown suddenly on and off, but, at the moment that the operator at the projector brings the carbons together, the dynamo is suddenly called upon to deliver over three-fourths of its total capacity.

Sixth—It should be efficient and run cool, the former in order to avoid the waste of energy and a corresponding amount of the coal supply and also in order to avoid overheating. The dynamo rooms on shipboard are, at best, warm, notwithstanding the motor fans, which are now usually supplied and thus the safe limit of extra heating is reduced. At the same time consideration for the attendants requires that the cramped space be kept as cool as possible.

Seventh—The dynamo should maintain a constant potential at all loads. This is, of course, accomplished by compounding, and, as there is only about three per cent. drop, it is usual to compound exactly or to only over-compound enough to allow for the decrease in the engine's speed with load.

Eighth—The dynamo should be light. The reasons are obvious, but it is considered last, because usually a careful study of the materials and arrangement of the plant, can accomplish more toward reducing the total weight than the strict adherence to a specification of watts per pound of dynamo. Thus, consider the difference between the weights of a forty horse-power ship plant and a five watts per pound specification, and upon a four watts specification. Two 200-ampere, 80 volt dynamos, with their share of the bed plates, will only weigh about 7,500 pounds. Twenty per cent. of this will be 1,500 pounds, an amount a large portion of which can really be saved in some cases by more careful attention to the amount of wire and moulding employed.

Naturally no one dynamo can best fill all of these conditions and while the order in which they are above arranged will usually approximate to their relative importance, special cases arise which demand a re-arrangement. Thus, on torpedo boats, the most important quality is small size. With this in view, numerous devices have been placed upon the market and faithfully tried, but none have to my knowledge proved satisfactory. The requirements of high efficiency, low speed and low heating, all give way in this class of dynamo to the necessity of compactness and light weight. Good results were hoped for from the Parsons turbo-electric generator; experience at Newport demonstrated that the turbine was so inefficient in its consumption of steam as to place its use out of the question. There is as yet no apparatus to satisfactorily fill this want.

Up to the present all of our ship plants contain two or more similar sets, each composed of an engine and one direct driven dynamo. The larger of these are of 200 amperes' capacity; a very convenient unit, but one which can be doubled in capacity with advantage in ships which are not light below decks and which are likely to soon have extensive motor applications; for example, vessels of the monitor type.

The voltage in use in the navy is eighty volts, this having been fixed upon as a mean between the most efficient pressure for the incandescent system and the voltage necessary for the search lights, to which current is supplied by the regular service machines. The incandescent lamps have given excellent results as to life from the very start, owing in great measure to the fact that low efficiency lamps are always used, nothing more economical than four watts per candle power being usually required.

Search lights of fifty volts and from fifty amperes up are used, two or more being supplied, according to the size of the ship. Some of these are imported, others are made in this country.

The two wire system has always been used in the naval service, the ship never being allowed to form the return circuit. On account of the present beginning of motor work on board ship and the future developments confidently looked for, the direct current has always been used. Motors have thus far been used only in driving small fans up to one-half horse power, for hoists, and in one case, a motor has been used for training one of the large guns—on the "Chicago." There are numerous small engines about a man-of-war varying from one to fifty horse power. Some of the smaller ones might even now be replaced with advantage by electric motors, but it must be proved in each case that the motor not only does the duty as well as the engine it replaces, but also that it, and any increase necessary in the generating plant take up less room and weigh less than the engine and its piping. This, of course, will always be the case where very small engines are replaced, and, as the tendency is to increase the capacity of the dynamo plant, it may not be long before motors may look for a larger field on board ship.

All circuits are water-tight from dynamo to a point of distribution, the cut-outs having stuffing boxes through which the lead-covered wires enter. Even the switches and attachment plugs for portables are required, in certain places, to be water-tight.

One electrical application that presents many advantages on board a man-of-war, especially when on a foreign station, is electrical welding. However, when it is introduced on ship board, the pressure of the generator should be reduced to eighty volts, in order that in case of emergency it might be used for lighting purposes, while the welders should have several sets of adjustable clamps. Welding machines have not yet been actually used on ship-board, but it is to be hoped that their introduction is a development of the near future. They cannot supplant any of the existing dynamos, owing to the necessity of motors, but must come in to occupy a place of their own to almost entirely supplant the ship's forge and add to the general useful equipment.

Thus the man-of-war is the proper field for nearly every form of application of electricity, and when the storage battery becomes more suited to the service there required, there is no doubt that it too will come in for its proper share of usefulness.

As to the naval work on shore in the electrical field, little need be said, as the practice at naval stations must be similar to that in ordinary commercial work. However, a navy yard is an ideal place for the erection of a central station for light and power. The streets must be lighted; closely grouped about the station are offices and large shops needing light in the dark afternoons and power for motor work; then in an outer approximate semicircle lie the officers' quarters, finally there are anchor chains to be welded, boiler tubes to be repaired, and numerous other similar operations which can be better accomplished by the welder than by any other known means. This in an ideal plant will call for arc lights, incandescent lights, constant potential motors, a welding generator and welders. The complete combination will probably not be realized at any one place within several years, but a good beginning has been made in the arc light plant recently installed for outside and shop lighting at the Washington navy yard, and the progressive plan adopted by the department leads us to hope that the shore stations will rapidly receive the benefits already enjoyed on ship board. Owing to the usually close grouping of the buildings and to the demand for motors, it is probable that only in exceptional cases will the alternating current be used extensively. Good use is already being made of small motors for drilling purposes at the New York navy yard, where several are in constant operation, having driven out the portable steam engine, countersbafting and belting.

The applications of electricity in the navy have always been on the increase, and any one who has served one cruise with oil lamps and one with electric lights and motors will understand the favor in which the increasing use of electricity is held by the naval men.

THE GENERAL MEETING.

After the adjournment of the annual meeting the members proceeded to Boston, by the Shore Line train at midnight, in order to take part in the general meeting for the reading and discussion of papers, which was fixed for the 21st of May, at the Massachusetts Institute of Technology. This was the first time since the Philadelphia Electrical Exhibition that a meeting of the institute has been held outside of New York City. About one-third of the membership is located in New York and vicinity, but the wonderful expansion of electrical interests in Boston has led to a corresponding increase in the eastern membership, and it was this reason, taken in connection with the close of the official term of President Elihu Thomson, that governed the council in arriving at what appears to have been an exceedingly wise decision. The New York delegation was met at 7 A. M., May 21st at the Boston and Providence station, by Messrs. H. B. Cram and A. L. Rohrer, a committee from the Boston Electric club, who escorted them to the Hotel Brunswick where the headquarters of the Institute were established in Parlor E.

The members and visitors registered were as follows: Ralph W. Pope, Elizabeth, N. J.; A. L. Rohrer, Lynn, Mass; A. A. Knudson, New York, N. Y.; Henry B. Cram, Boston, Mass.; J. P. Wintringham, Brooklyn, N. Y.; George G. Grower, Ansonia, Conn.; A. A. Dion, Moncton, N. B.; Alex. P. Wright, Boston, Mass.; Francis B. Crocker, New York City; A. Floyd Delafield, New York City; O. T. Crosby, New York City; Dr. Louis Bell, New York City; M. J. Francisco, Rutland, Vt.; Charles S. Bradley, Yonkers, N. Y.; Chas. R. Cross, Boston, Mass.; Edward L. Nichols, Ithaca, N. Y; Louis B. Marks, Ithaca, N. Y.; F. A. C. Perrine, Trenton, N. J.; F. L. Pope, Elizabeth, N. J.; R. W. Ryan, New York City; R. N. Bayles, New York City; Kenneth R. Stewart, London, Eng.; Wm. S. Turner, New York City; R. F. Ross, Boston, Mass.; L. S. Dumoulin, Boston, Mass; Geo. A. Hamilton, New York City; Elihu Thomson, Swampscott, Mass.; Geo. W. L. Blodgett, Auburndale, Mass.; Geo. F. Curtiss, Lynn, Mass.; Geo. B. Prescott, Jr., New York City; Wm. J. Hammer, Newark, N. J.; Joseph Wetzler, New York City; Edw. C. Caldwell, Boston, Mass.; Richard N. Dyer, New York City; E. W. Mix, Lynn, Mass.; Caryl D. Haskins, Lynn, Mass.; John S. Cobb, New York City; C. Wellman Parks, Troy, N.Y.; D. C. Jackson, New York City; Robert J. Pratt, Greenbush, N. Y.; Edwin H. Hall, Cambridge, Mass.; S. Katogi, Japan; John Tregoning, Lynn, Mass.; C. J. Spike, Halifax, N. S.; W. H. Sawyer, Providence, R. I.; H. Lemp, Lynn, Mass.; Herbert H. Eustis, Boston, Mass.; Geo. M. Phelps, New York City; Charles Wirt, New York City; W. H. Blood, Jr., Lynn, Mass.; Michael I. Pupin, New York City; W. L. Hooper, College Hill, Mass.; J. A. Wilber, Providence, R. I.; W. A. Anthony, Manchester, Conn; John W. Howell, Harrison, N. J.; Francis E. Jackson, Newark, N. J.; C. A. Shaw, Boston, Mass.; E. Wilber Rice, Jr., Lynn, Mass; Otis K. Stuart, Boston, Mass.; S. E. Barton, Boston, Mass.; G. L. Austin, Boston, Mass.; A. E. Dolbear, College Hill, Mass.; W. I. Barker, Boston, Mass.; George W. Mansfield, Boston, Mass.

At 10:15 A. M. the meeting was called to order, when General Francis A. Walker, president of the Massachusetts Institute of Technology, warmly welcomed the visiting members with a brief and fitting address, which he closed with a most eloquent tribute to the scientific achievements of the retiring president, Professor Thomson. The latter in his response, spoke of the great value of the Technology Institute to the country in training young men for the increasing demand for their services in the electrical field.

The papers were then read and discussed. In the absence of Wilfrid H. Fleming of New York, his paper on "Electric Lighting in the Tropics" was read by Joseph Wetzler.

Electric Lighting in the Tropics.

BY WILFRID H. FLEMING.

One of the chief difficulties that an engineer experiences who is called upon to install a plant of any considerable size in tropical countries is the trouble of procuring any kind of skilled labor for this particular class of work. Another difficulty is that he is so far from his base of operations—the factory—which will often lead him to depend upon himself in overcoming obstacles that arise from time to time as the work progresses. Language and the heat, as well as fevers, are minor affairs.

Electric lighting has already gained many warm adherents both in the East and West Indies, more especially in the former, where plants of considerable capacity have been in active operation for the past eight years. It is especially adapted for use in houses in warm climates, such as that of India, where the old-fashioned "punkah" is in daily and nightly use for cooling the rooms, accompanied with its attendant noise as the "punkah wallah," a servant, pulls it backward and forward, causing the continual flickering of the lamps or gas. That system will, I hope, give place to the noiseless motor fans and steady incandescents, thus enabling the Anglo-Indian to read and rest in comfort.

A central station plant that the writer was engaged upon lately in one of the chief cities of the West Indies, would compare favorably in size and equipment with one situated in a city of a corresponding number of inhabitants in the United States. Alternating current dynamos of a capacity of 4,500 16-candle power lamps were employed for lighting the chief stores, theaters and private houses, and 600 arc lights of 1200-candle power each lighted up the main streets and parks.

It was at first intended to run a small plant in connection with the existing gas works, more as an experiment than with a view to actual financial success, but in the space of six months the station was more than trebled from its original capacity.

The people took to it from the start, paying cheerfully the prices that were demanded. To an indolent race it was a great boon. Money to them, it would appear, was of less account than the trouble and work called upon to go around and light up the different oil and gas lamps, since all the lights were switched on the different circuits at sunset. In the tropics, as is well known, there is no twilight. Darkness comes on within ten minutes of sundown, and the whole plant practically goes into operation at once.

The construction work on this particular plant was necessarily slow, as men unaccustomed to erect a thirty or forty-five-foot pole took their time to do so, in which operation they received the appreciation of the usual army of idlers. Poles suitable for carrying a number of circuits had to be imported from the United States, as well as the ornamental wooden columns for supporting the lamps in the parks and public squares. Poles of native growth could not be found straight enough, and even if of sufficient length, were weak. Some poles could have been had from a tree called the ironwood tree. This wood, however, is of so close a grain and so very heavy that it was out of the question to use it. Many of the business streets were not more than from twenty to thirty feet across, including the sidewalks. Moreover, as curtains or awnings are stretched overhead from side to side, by the owners of the stores, to shelter and protect their goods from the sun's rays, it was impossible to erect a pole line down these streets. I found it better to run a two-inch iron piping up the side of the houses every 150 feet, to a point six feet above the coping stone, and then attaching to the top of this pipe a T, inserting in this T wooden cross-arms, to which the insulators were attached in the usual manner. It must be borne in mind that the houses are not of very great height. Where this arrangement was impracticable, owing to the varying heights of the houses, I inserted strong iron brackets in the buildings, set in with cement and well painted with rust-proof paint.

In India considerable care has to be exercised in putting up a pole line. If you want your work to stand any length of time, the base of the poles for one-sixth of their length must be thoroughly well creosoted to resist as far as possible the ravages of an insect called the white ant or "termite." These insects live on wood. They attack even the woodwork of the houses, and soon reduce the thickest timber to a mere shell. They live in trees and construct nests of great size, like small sugar casks, made of particles of gnawed wood and cemented by a kind of gluten. They are so strongly attached to the branches that they cannot be shaken down even by violent storms. It is a good plan to paint the poles eight feet above the surface of the ground with good gas tar if obtainable. In these climates special attention should be given to protecting the working parts of arc lamps, owing to the fact that rain occurs only for about three months of the year, and to make up for this loss the humidity of the atmosphere is remarkable. It is not at all infrequent to find early in the morning the bottom carbon holders full of water, unless provision is made for draining this off. During the hot season a breeze springs up between 9 and 10 o'clock in the morning and the ground being dry, the dust is terrific. Insects of a large size, much more so than those found in the northern climates—bats and small birds attracted by the glare are found either in the globes or lying at the base of the lamp posts in large quantities every morning, and the wholesale slaughter that takes place nightly seems to have no effect in diminishing these pests.

It was found better, therefore, on the arc service to give a man about twenty-five lamps to trim and clean per day, and the native intrusted with this work was held responsible, and if the lamps were found in a dirty condition he was fined, which usually had a good effect.

In the construction of station buildings one is guided much by the facilities for procuring stone, brick or other suitable material in that particular locality. Galvanized iron is sometimes used for roofing, but more frequently roofs are constructed of a sun-baked clay tile, provision being made as is usual for an ordinary wire tower for distributing the various circuits. A point to be noted is that the engineer should construct his rain-gutters for taking off the storm water at least double the size that is ordinarily allowed for temperate climates. Roofs and the outsides of the buildings are whitewashed.

To give an idea of the heat from the sun, I may mention that I had to replace considerable quantities of insulated wire after it had been up only a short time, the insulation in places sagging right away from the copper wire and finally dropping off. During the rainy season prevailing in the West Indies in the months of June, July and August, and in the East Indies, known by the name of the southwest monsoon, and prevailing from May to the latter part of August, electrical storms occur almost daily They are often exceptional in violence, and much trouble and anxiety arises from possible damage to line, lamps and dynamos, even though protected by good lightning arresters.

While a heavy storm was in progress one night last summer in the West Indies, I noticed when in the station a curious effect of a flash that fused the lead stripes on an ordinary saw-tooth arrester connected with one of the incandescent circuits. The strips were entirely destroyed or volatilized, and what was before a polished plate of brass was now tarnished with a film of the lead vapor, and there was distinctly marked as if photographed on the plate a zig-zag streak, in all appearance like a photograph that had been taken of lightning. Engineers, during the prevailing season of storms, should take particular pains that their lines and machines are thoroughly well protected, and that the arresters have good earth connections.

A sad case came under my notice that happened at a temporary installation for illuminating a camp at Poonah, in the Bombay Presidency, with arc lamps in honor of a visit of an influential rajah. While the festivities were taking place in the evening, a heavy storm occurred. Lightning entered on the line, no provision had been made for diverting its course, and it destroyed the dynamo, besides killing the native oiler, who just at that moment was engaged in filling up the oil cups on the bearings. He was either thrown or fell across the commutator end of the dynamo, as he was found in that position, his hands much burnt as well as his feet.

In the year 1877 the first commercial arc lamp was in use at the offices of the Bombay *Times*, and if I remember correctly it was the first light shown in the Indian empire. From that date on the demand for lighting has been on the increase; but pretty nearly all the work has been confined to isolated work and small central stations, cotton mills, sugar and indigo plantations, government buildings and large private dwelling houses. Places of business and offices do not require lighting, as business is conducted by the merchants only from 7 o'clock in the morning till 4 in the afternoon. The inhabitants of hot climates necessarily spend much of their time out of doors, and are fond of social gaiety. They have been famous for centuries for skill in illuminating, and this fact has added much to the popularity of arc and incandescent lamps, which, as is well-known, particularly lend themselves to artistic illuminating purposes. From this knowledge, in the early part of the year 1885, I imagined that it would be a financial success to get together a traveling portable electric light plant, consisting of a vertical boiler, engine and two dynamos, one an 8 arc light machine and the other a 100 light incandescent, both mounted on a stout frame which rested on a pair of bisel trucks. This work was carried out, and I was kept actively employed for many months in going round to different large Indian estates and native palaces for the fetes that attend the various religious and family ceremonies that the wealthy natives are fond of indulging in. Large sums of money are spent, and the festivities often last for a week or longer. It turned out to be as I surmised it would, a regular "bonanza," until on one occasion in bringing the unwieldy contrivance down a steep hill on one side of which was a ravine, it fell over; and it is needless to relate, that the whole apparatus was seriously damaged. I found it would not pay to patch it up again, so after stripping everything that was portable I left the remainder to lie and rust in the tropical vegetation.

Owing to the high price of coal, which is a costly article in the tropics, ranging from $8 to $50 per ton delivered, it is well to employ the most efficient and economical engine for motive power, more especially for central station work. In the station previously referred to, we were running with high speed compound condensing engines with satisfactory results.

In many sugar plantations in the West Indies where the installations are of a comparatively small size, economy in this direction is not practised as the amount of steam used is not missed, the boiler capacity on estates ranging from 100 H. P., to one at Cienfuegos, Cuba, of 2,500 H. P. It behooves the engineer, however, who has charge of a plant to exercise considerable care and watchfulness over his native firemen. The natives, as a rule, I have found, if treated with kindness and forbearance, show an aptitude in learning and taking hold that is often remarkable, more so than with some of their brethren of a lighter color who, because they have been taught how to start and stop a dynamo or trim an arc lamp, give themselves all the airs of an expert in electrical matters, and have got beyond that stage when they are willing to be instructed or to be obedient to orders, an unwillingness that sometimes leads to disastrous results.

The types of machines chiefly in use in the East Indies are those of English and French manufacturers, Siemens, Gramme, Silvertown and other well-known types. Those in use in the West Indies and South and Central America are generally of American make, and the market is not a small one. The great strides that both the foreign and home companies have made in the last two or three years in the supply and equipment of electrical plants for these distant lands are very evident signs that this particular business is receiving great attention at the hands of local merchants, planters and city or town officials and that they are more and more influenced by the many advantages to be gained by the use of electric lighting. Planters find now that it is much to their gain in a financial way. In former years, for example, the facilities of shipping their produce were restricted, and the work was done in daylight, and slowly. Now with weekly and almost daily sailings, it is an absolute necessity that they should get their produce ready with the quickest dispatch possible and this they do with the aid of the electric light. When an engineer is called upon to install or take charge of an electric light plant, it will be well for him to insist pretty closely not only that all the materials specified in the estimates have been shipped, but that every class of tool requisite for constructional work is included. Much time is lost and much trouble is made when you find that your outfit does not include "climbing spurs" or draw vises and other important articles. I have known engineers who have had expensive testing sets, Wheatstone bridges, reflecting galvanometers and other delicate instruments sent out with them, and then found that they had few or any tools to work with, and that the nearest hardware store was many miles away through a rough country, and even then, the store when reached did not contain the requisite goods, there having been no stock kept because there was no demand made for them. Spare armatures, complete sets of arc lamp apparatus as well as duplicate parts of dynamos, spare brasses and gear for engines and tubes for boilers should always be included, and it should be seen that they are shipped.

Apart from the vicissitudes incidental to life in the tropics, there is, I think, always a satisfaction and pleasure in the successful completion of an installation, knowing as one does that it is a potent factor in the greater civilization of those countries, demonstrating to the inhabitants, who have heretofore depended on artificial illumination of the same primitive character and manner as their forefathers used through past ages, what science aided by her lieutenants "pluck and energy" can accomplish.

Louis B. Marks of Ithaca, followed with a paper on the "Life and Efficiency of Arc Light Carbons," which was as follows:

Life and Efficiency of Arc Light Carbons.

BY LOUIS B. MARKS, M. E.

From the experimental stage of arc lighting to the commercial application of the system to-day, little or no increase in the efficiency of the carbon points appears to have been made.

Now that our dynamos and lamps have reached such a state of perfection, the subject presents itself as pre eminently important. The arc light pencil, considered as an individual part of the plant, is indeed a small thing, but in it undoubtedly lies the weak spot of the system.

It was with a view of studying the action of modern carbon pencils, that the investigations here to be described were undertaken. The carbons experimented upon were all of American manufacture, and were procured from five companies (A, B, C, D and E.)

While the greater part of the research was upon the life and efficiency of the pencils, observations were also made in other directions.

The subject will be treated under the following heads: 1st. Structure of the carbons. 2d. Life tests. 3d. Efficiencies. 4th. Candle-power measurements. 5th. Observations of the arc and carbon points.

It is well known that the life and efficiency of a carbon depend upon the system in which is turned. For instance, "The requirements of the low tension system seem to be a carbon that is hard, well plated and a good conductor, the latter being the most important.

"In the high tension system, on the contrary, hardness and conductivity seem to be of secondary importance. There is a tendency to 'flame' and burn unsteadily when a hard carbon is used in this system, and a softer one sometimes becomes necessary."[1]

It is interesting to note the methods employed by carbon manufacturers to attain the conditions above mentioned. In one of our largest carbon works "forced" carbons, or those made by "squirting" the plastic material through a die, are manufactured for both high and low tension systems of lighting, to the exclusion of moulded pencils. On the other hand, another company makes no forced carbons, but claims that its moulded pencils are superior for either system. From the classification given below, can be seen the types of carbons now upon the market for both systems:

Carbon.	High tension.	Low tension.
A	moulded	forced
B	"	moulded
C	"	"
D	forced	forced
E	moulded / forced	"

One of the first things that suggested itself was the study of the structure of the various samples submitted.

For this purpose, thin transverse sections of all the specimens were cut and mounted on glass slides, and a microscopical examination made.

The accompanying photographs (Figs. 1-12) show the appearance of a carbon under a magnifying power of about forty diameters in the case of groups A, B and C, and about eighty diameters in that of D and E. While the views cannot give either the color or luster of the original, they are mainly useful in conveying an idea of the texture of the surface.

Examining the photographs we note that there is a marked diffence between the structure of a moulded and a forced carbon. In the high tension pencil of the brand A, Fig. 1, the structure is a loose one, while the low tension rod of the same group is marked by a dense homogeneous structure; the size of the grains of carbon in the latter case is very much less than in the former, and as seen under the magnifying power of the microscope, the particles have a more metalloid luster. Again there is probably considerable air space in Fig. 1.

[1] G. W. Parker: Proceedings National Elec. Light Assoc'n, Pittsburg Convention, Feb., 1888, p. 455.

Thus it appears that Fig. 1 has the qualifications of a high tension carbon, i. e., looseness of structure, hence comparative softness and high resistance; and Fig. 2 the requisites of a low tension pencil, i. e , density, hardness and low resistance. The resistance of the rod, Fig. 1, was measured and found equal to .199 ohm; that of Fig. 2 equaled .144 ohm. The resistance of the plated low tension carbon was .084 ohm.

The structure of the carbon in group B (Figs. 3 and 4), was found after close examination to be about the same. To secure the requisite low resistance of Fig. 4 the pencil was heavily copper-plated, the thickness of the coating being about 1-10 millimeter, while that of Fig. 3 was a little less than 1-20 millimeter.

A method different than either of those just described is used in the manufacture of carbons C (Figs. 5 and 6). As in the previous instance, moulded carbons are made by this company for both high and low tension systems, but a much greater pressure is applied to the moulds in manufacturing low tension pencils than in the case of high. This accounts for the difference in structure exhibited in the photographs; although a molded carbon, Fig. 6, thus approaches the structure of the forced pencil, Fig. 2.

Groups D and E are highly magnified. An attempt has been made to manufacture a carbon that will burn fairly well in either system. Fig. 8 shows this carbon. In structure it is a mean between Fig. 7 and Fig. 9. Besides a difference in pressure used in constructing pencils of group D, there is also a difference in the "mix" or composition of the carbon.

The dissimilarity in structure between carbon E, Fig. 11 and E, Fig. 12 is apparent, yet both pencils are used in high tension systems. The efficiency of these types, as well as of the others, will be discussed later. Fig. 12, it will be noted, is very similar in structure to Fig. 9 (carbon D), in both cases the striations are marked and indicate that the carbon is built up of strata lying longitudioally, or in the same direction as the application of the pressure used in manufacturing the pencils. When examined with the microscope, carbon D (Fig. 9), evinced more luster than Fig. 12, showing that a greater quantity of pure carbon was used in the manufacture of the former.

Fig. 1. A.

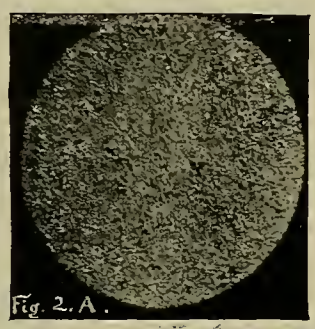


Fig. 2. A.

Fig. 3. B.

Fig. 4. B.

Fig. 5. C.

Fig. 6. C.

Fig. 7. D.

Fig. 8. D.

Fig. 9. D.

Fig. 10. E.

Fig. 11. E.

Fig. 12. E.

LIFE TESTS.

If a carbon is burned with a small current its life will be long, at a sacrifice of light-giving properties. If on the other hand a large current is used, there may be a gain in efficiency at a sacrifice of life. The question arises—what is the proper current to use? Of course circumstances determine to a large extent the answer, and generally such a current is used as gives a fair mortality at a reasonable efficiency of the carbon.

The high tension carbons submitted for test were designed to be burned at about 10 amperes and the low tension at about 20. In the life tests a Thomson lamp was used for high tension runs, current being kept constantly at 10 amperes and P. D. at 50 volts. For low tension carbons the Weston lamp was used.[2] The pencils were accurately weighed before and after the runs, and the life is calculated on the assumption that the carbons were homogeneous. Each set of pencils was burned an hour. The results of tests are given in Table 1.

It has been stated that "with carbons of the same *hardness* and length but having different diameters, the larger will undoubtedly outlive the smaller. Of carbons of the same *diameter* and length, but differing in hardness, the harder will outlive the softer."[3]

This statement pre-supposes that the conductivity of the carbon is directly dependent on the hardness or softness of the pencil.

In order to examine more fully the relation between diameter resistance and mortality of a pencil, six sets of carbons of the brand B, varying in diameter from ½ to 1½ inches were carefully weighed, their resistance measured by the Wheatstone Bridge method and the pencils burned with a constant current of 10 amperes from a Gramme dynamo, the P. D. at the terminals of the lamp being kept at 50 volts. The diameters and resistances respectively of the upper and lower carbons were in each case practically the same. A mean of ten micrometer measurements of the diameter, was taken as correct. The duration of each run was 60 minutes.

Following are the data:

From the results given in Table 2, it appears that the life of a carbon varies *directly* with its *diameter* and *inversely* with its *resistance*. This law holds only for homogeneous carbons of the same manufacture, type and structure, and as stated before, for constant current and voltage.

Let us take the ½ inch (.505") and 1 inch (.986") pencils as standards and from the relation above stated, calculate the mortality of the other carbons.

Table III gives a comparison of the actual and calculated life of the various specimens tested.

Thus it appears that the calculated life throughout the series is larger than the actual when the ½" carbon is taken as a standard and smaller when the 1" pencil is made the basis of calculation.

The carbons of group B were not perfectly round, a variation of 3° being at times found, between the ten measurements of the diameter of a pencil. In determining the resistance of the carbon rods, the tips of the latter were copper plated when necessary and mercurial contacts used. The lamp was adjusted to burn at fifty volts' potential difference for each set of pencils.

While every precaution was taken to avoid discrepancies, it is clear that from the nature of the substance experimented upon, and the extreme difficulty of maintaining constant conditions, errors are apt to creep into the work. But the results given in Table 3 as well as later determinations undoubtedly point to the existence of such a law as has been quoted.

The relation between diameter and life having been investigated, experiments were then made to determine the curve for current and mortality of the pencil, when the voltage is kept constaot.

For this purpose a number of moulded high tension carbons of the brand E were used. To secure uniformity in the plus and minus pencils, a 12-inch stick was broken in half, one portion being used as the upper, the other as the lower carbon. The length of each run was an hour. Current and potential were read every two minutes, and the mean taken.

Table 4 gives the data from which the curve for current and mortality (Fig. 3) was plotted.

As will be seen, the range of current was from 6 to 13 amperes. The greatest variation of the mean e. m. f., for the several runs was one volt.

A series of tests was now made with constant current and varying voltage. The current in this case was maintained at ten amperes, and the range in tension was from forty to sixty volts. Carbons of the same type as in the last instance were used. In Table 5, are given the figures for these runs, and Fig. 14 shows the curve for voltage and mortality.

In the curves, Figs. 13 and 14, the ordinates represent the life of an inch of carbon in minutes. Reference is made not to the mortality of the plus pencil, but to the total amount of carbon burned in the lamp. The last two columns of Table 5 have been corrected for diameter and resistance of the pencil, the diameter and resistance respectively of the carbon that was burned at 10 amperes and 45 volts having been taken as a standard, and the life of the other pencils reduced to a common basis from this, according to the law previously stated.

Very little has been published regarding the relative life of the plus and minus carbons. Those books in which the subject is alluded to, state as a rule with direct currents, the life of the upper carbon is about half that of the lower, provided both have the same length originally. In a recent publication[4] the general statement is made that "with continuous currents the plus wastes twice as fast as the minus carbon. With alternating currents the upper wastes 8 per cent. faster than the lower if the carbons are vertical; but at the same rate if horizontal."

No experiments were made upon arc light carbons fed by alternating currents, but an investigation of the relative loss of the plus and minus pencils with direct currents gave quite interesting results. Table 6 shows that the plus carbon may burn away about as fast as the minus, or may waste more than three and a half times as quickly.

Three sets of experiments were undertaken to determine the elements that affect this ratio.

First. Effect of changing the diameter and resistance of the pencils with constant current and potential.

Second. Influence of change of current with constant potential.

Third. Change of potential with constant current.

For determining the influence of diameter and resistance upon the relative life of the plus and minus carbons, a number of moulded high tension pencils of the brand A were used. The carbons were supposed to have been taken

[2] These low tension runs were made with the Weston plant on the University Campus. Ten lamps were run in series. Time of test was 2½ hours in the case of carbons B and E, and 2 hours and 25 min. in the case of C.

[3] G. W. Parker.

[4] Munro & Jamison's Electrical Rules and Tables, 1889.

from the same "batch" and were burned with a current of 10 amperes and a P. D.=50 volts.

Examining Table 7, which gives the results of measurements we note that $\left\{\frac{\text{life}-}{\text{life}+}\right\}$ appears to become greater with increase of diameter of the carbon. It is probable that the inequality in the diameters of the + and — pencils respectively, as well as the difference in the resistances of the two carbons of a set explains to a large extent the cause of this increase in the ratio. For, assuming that under the conditions maintained, the life of a carbon varies directly with its diameter and inversely with its resistance, the data (Table 7), indicate that if the diameters and resistances respectively of the + and — carbons were the same in each run, the ratio would be practically the same for all sizes of carbons. This is brought out in the last column of the table, which gives the corrected values of $\left\{\frac{\text{life}-}{\text{life}+}\right\}$.

Second. Reference to the last column of Table 4 will show that a change in the current, other conditions remaining the same, probably has no effect on the ratio $\left\{\frac{\text{life}-}{\text{life}+}\right\}$. For when a current of six amperes was used the ratio was equal to 1.62; at 7 amperes the ratio dropped to 1.54; it then alternately increased and decreased to 13 amperes. Hence it may be said that if all errors of observation, as well as those due to irregularities in the carbons could be eliminated the $\frac{\text{life} - \text{carbon}}{\text{life} + \text{carbon}}$ would be found to be constant.

Third. The last column of Table 5 contains the data for $\frac{\text{life} -}{\text{life} +}$ with different P. D.'s and constant current. From these calculations it appears that the ratio depends on the P. D. and that the greater the P. D., the more nearly does the former approach unity. The curve plotted from the figures in Table 5, is given in Fig. 15, the abscissæ being volts, and the ordinates representing the ratio of the life of the minus to the life of the plus carbon.

Thus the causes that influence the relative life of pencils of the same diameter, lie chiefly in the difference in the resistance of the carbons and the variations of P. D.

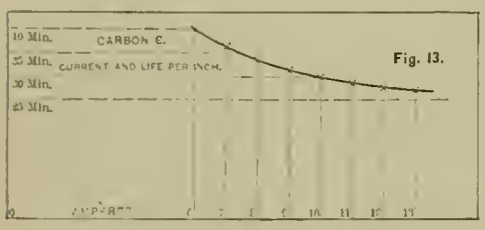


Fig. 13.

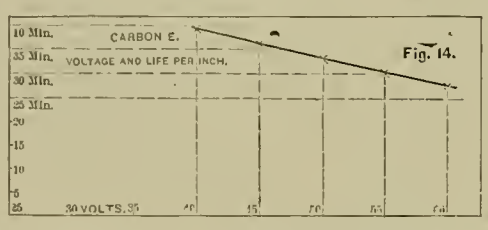


Fig. 14.

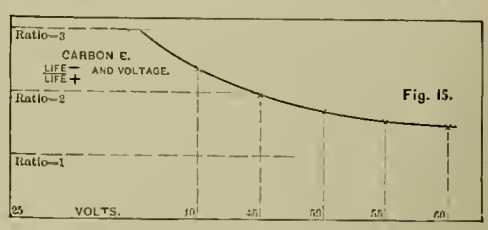


Fig. 15.

candle powers and will be referred to in the discussion of candle power measurements.

It may not be amiss to give here an outline of the first method employed. A Thomson lamp was mounted on a movable frame and the rays from the burning carbons allowed to fall on the face of a thermopile, the latter being in circuit with a sensitive Thomson galvanometer. The deflection of the galvanometer was taken as a measure for the energy of the total radiation which fell upon the face of the pile. A cell containing a solution of alum was then interposed between the light and the pile, and the reduced deflection of the galvanometer noted. On the supposition that the alum cell cut off all the "dark heat" and allowed only the rays of the visible spectrum to reach the face of the thermo-pile, the last measurement would give the true value of the luminous energy emitted by the lamp. But a small percentage of the longer wave lengths passes through the alum cell, and a large part of the luminous rays is cut off by its intervention. Corrections having been made for these factors, the true values of luminous radiation resulted.

A mechanism was provided by which measurements could be made at various angles below the horizontal plane without altering the distance between the center of the arc and the thermo-pile.

For the high tension runs, the lamp was fed by a current of 9 amperes, the potential difference between its terminals being kept at 45 volts. For low tension tests, current= 21½ amperes, and P. D.=30 volts. Note that the amount of energy expended in the low tension lamp was 21½×30 =645 watts, while the high tension required but 9×45= 405 watts. Although normally the former requires from 520 to 560 watts, unsteadiness of the light when the lamp was run below 21½ amperes made accurate measurements impossible.

Tables 8-15 give the results of efficiency tests. In the column headed L are given the corrected values of deflections due to luminous radiation; the values of T refer to total radiation and the efficiency or luminous divided by the total radiation $= \frac{L}{T}$. These tables furnish the data from which the curves Figs. 16–23 were platted. The radii show the positions for which measurements were taken and distances measured along these lines from the origin to the dotted curves give the intensity of luminous and total radiation respectively in each position. It will be seen that the distribution of total radiation differs considerably from that of luminous radiation, hence the efficiency which is expressed by luminous radiation / total radiation depends upon the angle of measurement.

The full line curves Figs. 16–23 represent the efficiencies of the various carbons. In order to obtain the mean or hemispherical efficiency the areas of the curves of luminous and of total radiation were found by means of the planometer; now the ratio of the radii of two semi circles whose areas are respectively equal to those of the curves of luminous and total radiation is the value of the mean spherical efficiency. This value has been calculated for each set of pencils and the results are given in Table 16; also in Figs. 16–23.

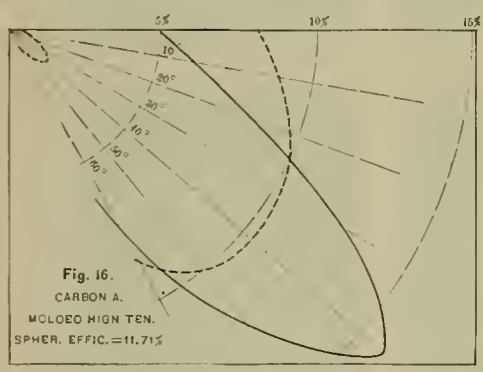


Fig. 16.
CARBON A.
MOLDED HIGH TEN.
SPHER. EFFIC.=11.71%

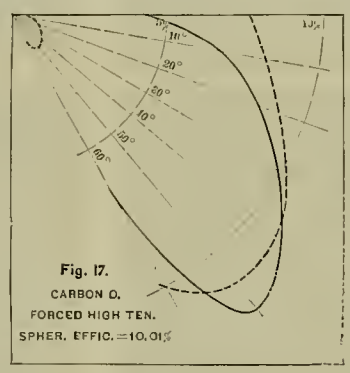


Fig. 17.
CARBON D.
FORCED HIGH TEN.
SPHER. EFFIC.=10.01%

We notice that the horizontal efficiency is very small compared with the maximum; that relatively high efficiency in a *forced high tension* carbon is obtained only at the expense of life; that a *moulded* carbon is, generally speaking, superior to a *forced* for high tension and vice versa for low tension.

In the case of the high tension carbons B and D, the diameters are smaller than those of the other pencils, hence we are to expect a relatively higher efficiency since, as was shown last year, the "efficiency varies inversely as the diameter."[7]

A point of interest brought out by these tests (Tables 10 and 11 and Figs. 18 and 19), is the fact that while the life of a copper plated carbon is greater than that of an unplated carbon of the same diameter and type, the mean spherical efficiency appears to be the same for both.

Two sets of pencils of the brand B, the one unplated and the other plated, were burned to ascertain this relation. The results show that the horizontal and the maximum efficiency of the copper-plated carbons were a little greater than those of the uncoated pencils respectively, and the mean spherical efficiency in the latter case was very slightly less than in the former. As can be seen from Table 16, the life of the "positive" plated pencil (12 inches long) was 10.64 hours, while that of the naked carbon was 9.16 hours, the current and P. D having been the same for both cases.

No positive explanation of this phenomenon has yet been given but it appears that the actual amount of *combustion* in both cases is the same, while the *disintegration* caused by the passage of the current is greater in the case of the unplated carbon.

CANDLE POWER MEASUREMENTS.

The candle-power measurements consisted chiefly in the determination of the hemi spherical candle-power of the different pencils, and from this quantity, the watts per spherical candle-power produced.

The runs were made under the same conditions as in the efficiency tests. For high tension carbons, current = 9 amperes and P. D. = 45 volts. For low tension pencils, current = 21 5 amperes and P. D. = 30 volts.

To ascertain the candle-powers, the method of the Franklin Institute committee was used.[8] The photometric apparatus was somewhat different in detail from that ordinarily used in measuring the candle-power of incandescent lamps and deserves a brief description.

The arc lamp was suspended from an arm which could be rotated about an axis parallel to the photometer bar and vertically above it. By manipulatiog a rope connected with the arm, the latter could be raised until it was at right angles with the photometer bar, or lowered until it was horizontal. The arm being horizontal, the lamp was hung from its extremity so that the arc was on a level with the center of the photometer-disc. It will be seen that when the arm was pulled up, the arc described a vertical circle, the axis of which was a line parallel to the photometer-bar, and passing through the center of the disc. The center of the vertical circle was at the point (800) of a scale graduated into 1,000 divisions, and the radius equal to the length of 200 scale divisions.

At the zero of the scale was placed a Weston incandescent lamp, and a circular mirror of silvered glass, the axis of which was horizontal and inclined 45° to the reflecting surface, was mounted on the bar so that its center coincided exactly with the 800th division of the scale. Thus the distance between the arc lamp and the mirror was rendered constant for all elevations of the former, and when the mirror reflected the light of the lamp upon the disc, the angles of incidence and reflection were always equal to 45°. The virtual image of the arc under these circumstances was at the 1,000th division of the scale. The Weston lamp was used as a secondary standard and maintained by a storage battery throughout the runs at 115 volts; its candle power was ascertained before and after the tests by comparing it with a standard Methven "Board of Trade" 2 c. p. slit.

Photometer readings were made as in the case of the efficiency tests, at 0° and at 10°, 20°, 30°, 40°, 50°, and 60°, below the horizontal, the mean of twenty observations being taken for each elevation. These measurements were

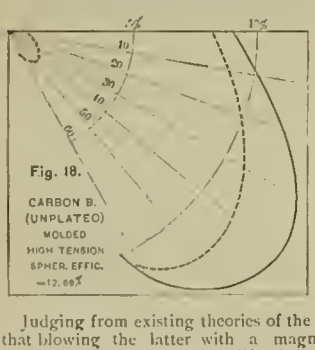


Fig. 18.
CARBON B.
(UNPLATED)
MOLDED
HIGH TENSION
SPHER. EFFIC.
=12.68%

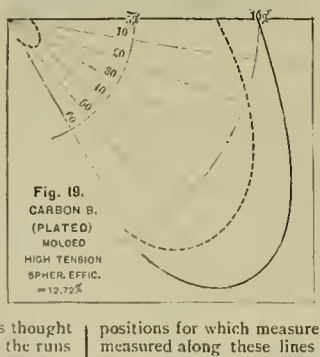


Fig. 19.
CARBON B.
(PLATED)
MOLDED
HIGH TENSION
SPHER. EFFIC.
=12.72%

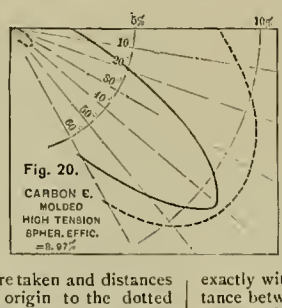


Fig. 20.
CARBON E.
MOLDED
HIGH TENSION
SPHER. EFFIC.
=8.97%

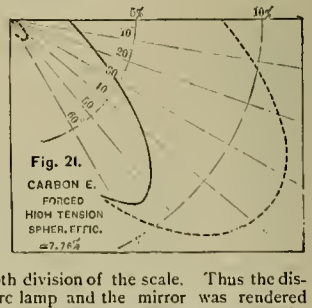


Fig. 21.
CARBON E.
FORCED
HIGH TENSION
SPHER. EFFIC.
=7.76%

Judging from existing theories of the arc, it was thought that blowing the latter with a magnet during the runs would relatively increase the life of the plus carbon. The experiment was tried and the reverse found to take place, i. e., the ratio $\left\{\frac{\text{life} -}{\text{life} +}\right\}$ increased while the life of the minus pencil was not much affected.

EFFICIENCIES.

Two methods of determining the efficiency of each set of pencils were employed. The first was the method used by Mr. Merritt in obtaining the efficiency of the incandescent lamp[5] and subsequently by Mr. Nakano in his work on the efficiency of the arc lamp[6]. The second dealt with

[5] E. G. Merritt: Some Determinations of the Energy of the Light from Incandescent Lamps. Amer. Jour. Science, Vol. 37, p. 167.

[6] H. Nakano: Efficiency of the Arc Lamp; Transactions Amer. Inst. Elec. Eng. Vol. VI, p. 308.

[7] H. Nakono.

[8] Reports International Electrical Exhibition of Franklin Inst. 1884. Group B, Sections V and VIII.

multiplied by the candle-power of the secondary standard and corrected for absorption of light by the mirror.

Tables 17–23 give the corrected data, which form the basis of the candle-power, curves Figs. 24 and 25. Distances measured along the radii from the origin to each curve, give the candle-power for the various angles. The mean spherical candle-power for any case is measured by the radius of a semicircle whose arc is equal to the area of the c. p. curve.

Although great care was taken in ascertaining the candle powers, the difference in color between the light emitted by the arc and that given by the standard was so marked that the settling of the photometer-carriage was to a large extent a matter of personal judgment; hence the measurements given cannot be considered as absolute, but rather as relative values.

The conclusions drawn from the efficiency curves hold generally, as will be seen by an examination of Table 24, for the candle-power curves. From the latter it appears that the efficiency of low tension carbons, and especially of *moulded* low tension pencils, is comparatively small.

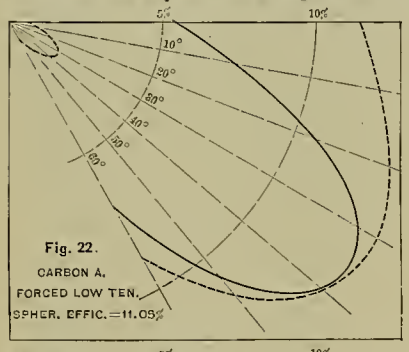


Fig. 22.
CARBON A.
FORCED LOW TEN.
SPHER. EFFIC.=11.05%

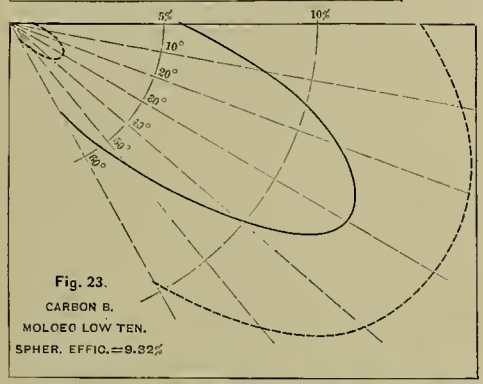


Fig. 23.
CARBON B.
MOLDED LOW TEN.
SPHER. EFFIC.=9.32%

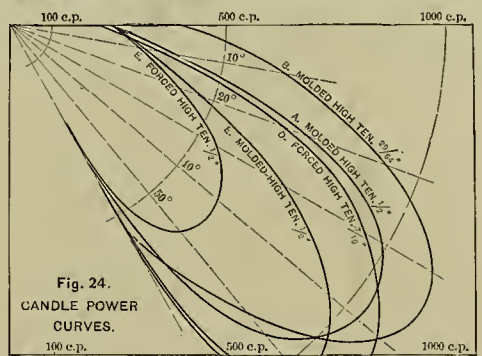


Fig. 24.
CANDLE POWER
CURVES.

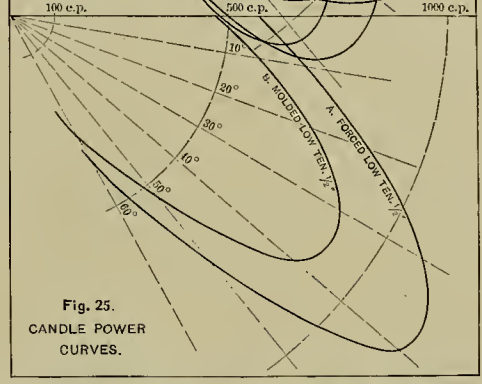


Fig. 25.
CANDLE POWER
CURVES.

FIG. 27.

Form of the Carbon Points: Constant Current=10 Amperes.

While the efficiencies of moulded high tension carbons are as high as .953 and .888 watts per spherical candle or 783 and 840 candles per electrical horse power expended in the lamp, the efficiencies of low tension pencils of nearly the same diameter as the high are as small as 1.255 and 1.612 watts per candle, or 594 and 502 candles per electrical horse power.

FIG. 26.

Form of the Carbon Points: Constant Potential=50 volts.

This fact is not brought out in Table 16, for reference to the latter shows the low tension pencils to have a rather high efficiency, and in some cases considerably higher than the high tension carbons. However, when the energy expended in the lamp in the two cases respectively is taken into account, the explanation of the high values for carbons A and B (Table 16, low tension) is apparent. Carbon B (molded high tension, Table 24), it will be noted has the highest efficiency of the group. This due largely to the fact that its diameter is smaller than that of any of the others, for "the candle-power varies inversely as the diameter."[9]

TABLE 1.
LIFE TESTS.

CARBON.	Mean Diameter; inches.	Resis. ohms.	Initial wt. + grms.	Initial wt. − grms.	C amperes.	P. D. volts	Loss in wt. + grms.	Loss wt. − grms.	Life 12 inch + carbon hours.
A molded high ten. (naked)	.502	.199	59 87	25.10	10.	50	5.86	3.50	10.22
A forced low ten. (plated)	.500	.072	64.89	27.16	21.5	30	6 15	4 13	10.55
B molded high ten. (plated)	.505	.075	58 17	28.32	10.	60	4 80	2.44	12.12
B molded low ten. (plated)	498	.071	367.80	295.30	22.5	28	166.60	51.50	9.42
C molded high ten. (naked)	.510	.2165	62.94	29.03	10.	50	6 21	3.63	10.13
C molded low ten. (plated)	.515	.0715	594.40	294.50	22.5	28	151 60	41 0	9 83[1]
D forced low ten. (plated)	.506	.095	62.46	38.10	21.5	30	6.92	3.08	9.03
D forced high or low ten. (plated)	.504	.142	60 58	29.78	10	50	6.65	4.16	9.11
D forced high ten (naked)	457	.187	47.20	23.53	10	50	5.46	3.29	8.64
E forced low ten. (naked)	.505	.2207	844.68	244 64	22.5	28	193 18	74.42	7 71[1]
E molded high ten. (naked)	.533	.202	68 80	30.48	10.	50	6.09	3.04	10 39
E forced low ten. (naked)	.522	.251	59.62	29 81	10.	50	5.91	3.52	10.09

Similarly the relatively high candle-power of carbon *D* is accounted for by the small diameter of the pencil. In Table 24 and the candle-power curves, we again note the comparatively small efficiency of forced high tension carbons.

The efficiency of carbon *A*. (moulded high tension, Table 16), as measured by $\left\{\frac{\text{luminous radiation}}{\text{total radiation}}\right\}$ is larger than that of carbon *D;* yet the mean spherical candle power of the latter is greater than that of the former (Table 24). The explanation of this phenomenon (assuming the measurements to be correct), probably lies in difference in the quality of the light emitted.[10]

TABLE 2.
MORTALITY WITH DIFFERENT DIAMETERS.

CARBON	Mean Diameter; inches.	Resis. ohms.	Initial wt. + grms.	Loss wt. + grms.	Life 12 Inch + carbon hours.
B molded high ten	.453	.0805	44.70	4.20	10 64
" "	.505	.075	58.17	4.80	12 12
" "	618	9735	94 93	6.96	13.64
" "	739	0615	132.84	6.19	21.38
" "	986	.061	232.20	8.88	26.15
" "	1 195	.059	339.57	10.14	33 49

In some instances it is desirable to ascertain the mean spherical candle power of a lamp approximately, without taking the time to integrate the curve.

The formula given by M. Gerard, namely, "spherical candle power = $\frac{2}{3}$ horizontal candle power + $\frac{1}{3}$ maximum candle power,"[11] is of sufficient exactitude for practical purposes. Gerard gives the following table showing the observed and calculated spherical candle powers for seven lamps.

TABLE 3.

CARBON.	Mean Diam. inches.	Standard=4" (.505") Calculated life hours.	Standard 1" (.986") Calculated life hours.	Actual life hours
B molded light.	453	10.92	9.32	10 64
" "	.618	15 10	13.62	13 64
" "	739	21.58	19 44	21.38
" "	1.195	36.40	33 04	33.49

Taking the whole number of lamps, the average error is only 5 per cent. "The angle of maximum intensity was about 45° usually, but in some cases it approached that of 30° or 60° from the horizontal."

Data collected from various sources, including the tests of the Franklin Institute Committee in 1884, are given in Table 26. From the horizontal and maximum candle-powers, the mean spherical was calculated by Gerard's law. Comparison with the observed candle powers shows that in some cases the error is less than 1 per cent. The mean error is, however, larger than that obtained by Gerard, and reaches about 9¾ per cent. Hence, as was stated

9 M. Schreihage: Centralblatt fur Elektrotechnik, No. 22, 1888.

10 The reader is referred in this connection to, "A Spectrophotometric Comparison of Artificial Sources of Illumination." Paper by Edward L. Nichols and W. S. Franklin, read before A A A. S. at Cleveland, August, 1888.

11 M. Gerard: Candle Power of Arc Lamps:—Centralblatt fur Electrotechnik, also N. Y. Elec. World, Jan. 25, 1890.

before, the law is valueless except in cases of rough approximation.

Reference has been made to the fact that while the curve for luminous radiation is similar to that of candle power, the curve for total radiation differs widely from the latter. As the efficiency depends upon the ratio $\left(\frac{\text{luminous radiation}}{\text{total radiation}}\right)$ it is plain that Gerard's law will not hold for calculating the mean spherical efficiency from the horizontal and the maximum. But again, for approximations a similar law holds, *i. e.*,

Spherical efficiency = ⅓ horizontal + ⅔ maximum.

Although the topic of efficiencies has been discussed in another part of the article, it may not be out of place to add a few words here, bearing upon the law in question. Measuremeots of horizontal, maximum and mean spherical efficiency, made by Mr. H. Nakano and by the writer,

TABLE 4

Life with Different Currents and Constant Potential

Carbon	Diam mean inches	Resis. ohms	Initial wt + grms.	Initial wt − grms.	C amp	P D volts	Loss wt + grms.	Loss wt. − grms.	Life per inch Carbon burned, hours. Life − / Life +
E molded high ten	.512	199	30 20	21 15	6 02	49.3	4 48	2.77	6723 / 1.62
"	"	"	25 72	18 38	7.04	49 7	4 87	3 19	.6047 / 1 54
"	"	"	20 85	15 19	8.01	49 9	5 42	3 25	5622 / 1 66
"	"	"	37 86	24 16	9 99	49 9	5.81	3 63	.5450 / 1 60
"	"	"	31 75	20 53	10 01	49 3	6 16	3 98	.5072 / 1 52
"			30 52	21 72	11 00	50.2	6 67	4.18	4910 / 1 60
"			54 30	26 99	12 03	50 3	6 65	4 35	.4837 / 1 52
"			37 78	26 33	18 00	50 1	7 26	4 61	.4502 / 1 57

TABLE 5

Life with Different Potentials and Constant Current.

Carbon	Mean Diam. inches. +	Mean Diam. inches. −	Resis. ohms	Initial wt. + grms.	Initial wt. − grms.	C. amperes	P. D. volts.	Loss wt. + grms.	Loss wt. − grms.	Life per inch Carbon burned, hours. Life − / Life +
E molded high ten.	.513	.518	199	51 58	48.32	10	40	5 625	2.32	.6425 / 2.344
"	.521	.517	197	37.65	24.16	10	45	5.665	2.87	.6077 / 1.953
"	.531	.523	185	24.86	10.06	10	50	5 83	3.49	.5458 / 1.698
"	.531	.522	185	24.86	10.06	10	55	6 34	4.025	.4903 / 1.580
"	.527	.530	191	23.52	19 84	10	60	6.70	4.41	.4525 / 1.484

TABLE 6.

Relative Life of the Plus and Minus Carbons

Carbon	Initial wt + grms.	Initial wt − grms.	C amperes.	P. D volts	Length run; minutes.	Loss wt + grms.	Loss wt − grms.	Life I'− / Life I'+
B molded high ten	48 28	25.22	10	50	60	6.28	4.40	1.29
B molded low ten.	61 45	31 37	10	50	60	5.14	8.27	1.67
A molded high ten	90 67	58 68	10	50	60	5.98	8.20	1 87
10 E forced low ten	344 68	244.64	22½	28	150	193 18	74 42	2.59
10 B molded low ten.	367.80	259 50	22½	28	150	166.60	51.60	3 23
10 C molded low ten.	691 40	294 50	22½	28	145	151.00	11.00	3.68

TABLE 7

Influence of Diameter and Resistance of the Carbon upon the Relative Life of the + and − Pencils.

Carbon.	Mean diam. inches +	Mean diam. inches −	Resis. Ohms +	Resis. Ohms −	Initial wt. +	Initial wt. −	Loss wt. +	Loss wt. −	Life I'− / Life I'+	Life I'+ / Life I'−	cor rected
A molded high ten	.3964	.4 68	255	.24	37.91	16 97	4 96	3.04	1.63	1.79	
"	.4567	4567	.235	243	48.98	20.20	5 41	3 2	1.65	1 78	
"	.5018	.5153	199	.207	59.67	25 10	5 86	3 69	1 68	1.74	
"	.5698	.5622	.178	.190	69.83	28.91	6.23	3.61	1 78	1.81	
"	.6311	.6268	152	140	90.57	38.68	5 98	3 20	1.87	1.82	

are given in Table 27, and the last law mentioned applied in the calculation of the spherical efficiency. In some cases the error is exceedingly small, while in others it is comparatively large; the mean error of fourteen tests is not quite 8 per cent.

Observations on the Arc and the Carbon-points.

With a given potential difference between the terminals of the lamp, the length of the arc depends upon the current flowing, and increases as the current becomes greater. If the current be kept constant, the length of the arc increases with the P. D.

Data given in Tables 28 and 29 show the length of the arc for both cases.

In order to measure the length of the arc, a lens was so mounted as to throw the magnified image of the former upon a surface carrying a vertical scale. Then, after measuring the distance between the magnified points, and applying the proper reduction factor, an additive correction was made for the depth of the crater, thus giving the length of an arc from the tip of the minus pencil to the point directly above in the center of the crater of the plus.

From the figures (Tables 28 and 29), it seems that no direct relation exists between the length of the arc and the current and P. D. In the case of the carbons tested, the length of the arc with constant potential increased very rapidly as the current was changed from 6 to 9 amperes, and then gained slowly from 9 to 13 amperes. The nature of the change was somewhat different in the constant current runs, the length of the arc increasing more nearly as the square of the voltage.

After each of the runs noted in Tables 28 and 29, the carbon-points were examined, and it was found that the latter assumed particular shapes depending upon the current and P. D used. Another series of tests was made with carbons C. and E. (moulded high ten.), in which the current ranged from 5 to 15 amperes, the P. D. being kept constant at 50 volts.

Fig. 26 shows the form of the points with different currents. Nos. 1, 2 and 3 are pencils of the brand C and 4, 5, 6 and 7 of the type E. The photographs of the carbons are three-quarters of the actual size.

Examining the first three pencils, we see that with 5 amperes, there is a tendency to form a "mushroom" on the lower or negative carbon; the latter is eaten away considerably just below the tip. With 10 amperes this tendency is not at all marked and at 15, almost inappreciable.

Glancing at the upper or plus carbons, it appears that the smaller the current, the more nearly does the positive pencil burn to a point, that is, the smaller the diameter of the crater. But though the width of the crater is less in the case of low currents than with high, the depth of the former is correspondingly greater. The photographs do not bring out this point, but an inspection of the tip of the lower carbon gives a clue to the facts Note that with small currents the negative electrode terminates in a pointed, sometimes globular projection. As has been stated before, this tip becomes less noticeable with increase of current, a fact which is brought out by inspecting Nos. 7, 6, 5 and 4 (Fig. 26). In No. 4, burned at 15 amperes, the end of the lower carbon is blunted; the depth of the crater in the upper was practically zero. In Nos. 5, 6 and 7, burned at 12, 9 and 6 amperes respectively, the depth of the crater increases as the current diminishes.

With high currents, the carbon is disintegrated to a greater distance above the point than with low.

Fig. 27 shows the form of the carbon points when the latter are burned with constant current=10 amperes. The range in P. D. was from 40 to 60 volts.

Just as the peculiar burning of the tip distinguishes a pencil fed by a low from one burned at a high current, so the form of the carbon point differs in the case of a pencil burned with low voltage than with high In Nos 1, 2, 3, 4 and 5, Fig. 27, the gradual change in the formation, from a sharp projection at 40 volts to a blunt end at 60 volts, is noticeable.

The "mushroom" which invariably forms in carbons burned at a low current and high voltage is absent when

Efficency Measurements.

TABLE 8

Carbon A Molded High Tension.

Angle.	L	T	L/T
0°	6.085	110	.0553
10°	8 112	130	.0624
20°	11.49	134	.0859
30°	16 90	140	.1158
40°	23.67	146	.1621
50°	15.65	143	.1087
60°	10 14	125	.0811

TABLE 9

Carbon D. Forced High Tension.

Angle.	L	T	L/T
0°	4 733	107	.0442
10°	8.138	118	.0688
20°	11.49	129	.0891
30°	14.20	142	.0977
40°	16.81	153	.1113
50°	19.81	156	.1257
60°	8.790	142	.0619

TABLE 10

Carbon B. UNPLATED Molded High Ten

Angle.	L	T	L/T
0°	10.14	114	.0889
10°	18.52	127	.1065
20°	15 55	144	.1080
30°	18.26	157	.1163
40°	22 81	165	.1352
50°	22.81	163	.1352
60°	15.55	156	.0985

TABLE 11

Carbon B PLATED Molded High Ten.

Angle.	L	T	L/T
0°	11 49	113	.0991
10°	14.31	128	1057
20°	15.55	145	.1552
30°	19.60	157	.1248
40°	22.31	164	.1351
50°	18.53	151	1269
60°	15.55	151	.1153

TABLE 12.

Carbon E Molded High Tension

Angle	L	T	L/T
0°	2 702	116	.0298
10	5 405	134	.0408
20°	8.108	146	0555
30°	13 51	157	0881
40°	17.57	159	.1105
50°	11 48	145	.0792
60°	7 77	112	0710

TABLE 13.

Carbon E. Forced High Tension.

Angle.	L	T	L/T
0	2.702	118.5	.0228
10°	4.054	131 0	.0310
20°	8.756	158.	.0428
30°	6.081	—	.0468
40°	10.13	175.0	.0570
50°	14.19	155.0	.0896
60°	11.48	136.0	.0844

TABLE 14.

Carbon A Forced Low Tension.

Angle.	L	T	L/T
0°	6.784	163	.0542
10°	12 16	170	.0715
20	20 27	185	.1095
30	25 68	190	.1361
40	25.68	190	.1351
50°	16 89	157	.1080
60	9 459	130	0728

TABLE 15.

Carbon B. Molded Low Tension

Angle.	L	T	L/T
0°	10.81	190	0569
10°	17 57	211	.0833
20°	25.68	223	.1151
30°	28 38	223	.1273
40°	17.57	216	.0817
50°	12.33	182	.0678
60°	6.081	135	.0451

TABLE 16.

Efficiency Measurements

Carbon	Diam. mean inches	Resis. ohms	C amp	P D volts	Horizontal efficiency	Maximum efficiency.	Hemi spherical efficiency.	Life 12 inch carbon hours.	C / P D
A molded high ten	.508	.203	9	45	.0553	.1621	.1171	10.22(10-50)	
D forced high ten	.457	.187	9	45	.0442	.1257	.1001	8.64(10-50)	
B molded (unplated) high ten	.453	.224	9	45	.0889	.1352	.1269	9.10(10-50)	
B molded (plated) high ten	.453	.0805	9	45	.0991	.1369	.1272	10.64(10-50)	
E molded high ten	.533	.202	9	45	.0233	.1105	.0896	10.39(10-50)	
E forced high ten	.522	.251	9	45	.0228	.0896	.0770	10.09(10-50)	
A forced low ten	.590	.072	21 5	30	.0542	.1351	.1165	10.55(21½-30)	
B molded low ten.	.498	.071	21 5	30	.0569	.1273	.0933	9.42(22½-28)	

Candle Power Measurements.

TABLE 17.

Carbon A, molded high tension

Angle.	Candle-power
0°	221 3
10°	474.1
20	713.1
30	979 2
40	1053 0
50°	928 6
60	370 7

TABLE 18.

Carbon B, molded high tension

Angle	Candle-power
0	882.2
10	638.4
20	908 4
30°	1113.
40°	1131.
50°	749 3
60°	579 8

TABLE 19.

Carbon D forced high tension

Angle.	Candle-power
0°	210 5
10	407.4
20°	687 4
30°	977.1
40°	1079 0
50°	1140
60°	505 7

TABLE 20.

Carbon E; molded high tension

Angle.	Candle-power
0°	227.3
10°	288.8
20°	429 9
30°	722.2
40°	957 2
50°	1080.0
60°	414.0

TABLE 21.

Carbon E, forced high tension

Angle.	Candle-power
0	221 7
10°	238.
20°	350 1
30°	559.9
40°	626.3
50°	630.7
60°	265 5

TABLE 22.

Carbon A forced low tension

Angle	Candle-power
0°	593 7
10°	712.1
20°	860.8
30°	1094
40°	1183
50°	682 2
60°	495.4

TABLE 23

Carbon B, molded low tension

Angle.	Candle-power
0°	476.4
10°	598 7
20°	720.9
30°	871.8
40°	866.8
50°	526 4
60°	354.8

TABLE 24

Candle Power Measurements

Carbons.	Diam (mean) inches.	Resis ohms.	C. amp.	P D volts	Horizontal Candle-power.	Maximum c. p.	Hemi-spherical c. p	Watts per spher p c	Spher. c. p. per Elec horse-power.
A molded high ten.	508	203	9	45	221	1053	456	888	810
D forced high ten.	457	.187	9	45	210	1140	486	833	895
B unplated molded high ten.	453	224	9	45	382	1131	525	771	967
E molded high ten.	633	202	9	45	227	1080	425	953	783
E forced high ten.	522	251	9	45	222	626	288	1 407	681
A forced low ten.	.590	072	21 5	30	591	1183	544	1 255	594
B molded low ten.	498	071	21.5	30	475	871	400	1 612	502

TABLE 25.

Gerard's Measurements of Candle Power.

Lamp.	Horizontal c p	Maximum c. p.	Spherical c. p. calculated.	Spherical c. p. observed
No. 1	250	1484	491	470
" 2	458	3250	1040	1145
" 3	680	3071	1048	1231
" 4	744	1227	679	692
" 5	122	840	371	274
" 6	588	2100	818	803
" 7	935	1150	755	787

the pencils are burned at high current and low voltage.[12] In the former instance the thin neck of the "mushroom" often breaks, thus arresting the current and extinguishing the arc. In the latter case the end of the carbon is prone to so burn away as to leave a concave outline. (See No. 1, Fig. 27).

At 40 volts the depth of the crater measured .051 inch. At 60 volts the crater disappeared; the carbons also "flamed" at this high voltage.

With a given current there is for every brand of carbon a certain voltage, above which, if the pencil be burned, "flaming" will result. A simple trial is sufficient to determine this critical point.[13] Again there is a voltage, below which, if the carbon be burned, "hissing" takes place. With perfectly centered carbons there is no difficulty in ascertaining the latter point.

Careful observation of the arc shows that when the tension is too high for a given carbon, the walls of the crater break away, allowing the arc to play on the outside surface of the carbon. This action is always accompanied by a flame, which shoots from the negative carbon. On placing the negative pencil above and the positive below, the flame shoots down. With soft-cored carbons, well centered, one cause of flaming, viz., liability of the arc to play laterally,—is obviated; and if the pencils be burned with the proper current and voltage, there seems to be no reason why this disagreeable feature of the arc lamp should not be entirely overcome.

There is not so much liability to "hiss" in a high tension system as in a low, for from the formation of the carbon-points when the pencils are burned in commercial low tension lamps, it appears that the minus carbon terminates in a small mushroom-button. The breaking of this pellicle of carbon and the consequent action of the lamp mechanism to reduce the rise in potential due to the rupture, invariably result in the "hissing" of the arc.

Most of the irregularities in the action of arc-lamps probably result more from the unsuitableness of the carbon than from defects in the lamp mechanism or changes in the strength of the current and P. D. in the line.

The remedy lies with the carbon manufacturer. A careful study of the relation between the microscopical structure of the pencil and the action of the latter in a given case would be likely to bear fruitful results. Of course the field for experimentation is large, but the improvements which must necessarily follow conscientious research will undoubtedly be of great scientific as well as commercial value.

In the present state of the art of carbon-manufacture, it is the central station manager who must exercise great discrimination in the selection of arc light pencils for his plant. E. F. Peck has recently shown how a "comparative test of the best known carbons in the market" resulted in "a saving of 64.73 electrical horse-power in a station burning a thousand arc-lamps."[14]

But there is no reason why the carbon manufacturer, given the condition of a lighting system as regards current, tension, required light and life of pencils, etc., should not be able to produce a carbon specially adapted to the needs of that system.

When the root of existing defects is thus struck at, the solution of the arc light carbon problem will be at hand.

The experiments published in this paper were made under the direction of Prof. Edward L. Nichols, in the laboratory of Cornell University. The writer is indebted to A. B. Levy, R. G., for valuable assistance in the work.

Dr. Edward L. Nichols of Ithaca, N. Y., read a paper entitled "Note on a New Photometer," as follows:

TABLE 26.

Candle-Power Calculations, using Gérards' Law.

Lamps.	Horizon c. p.	Max. c. p.	Spherical c. p. observed.	Spherical c. p. Calculated.	Authority.
Weston	344	609	848	324	B. W. Snow.
"	299	576	295	293	"
"	576	1235	640	597	"
Brush	313	1393	609	504	"
Ball	233	534	240	249	Prof. W. A. Anthony
Brush (1200 c. p.)	180	617	263	244	"
Brush (2000 c. p.)	389	1380	653	639	"
Van Depoele (20 light)	451	1377	574	569	"
Van Depoele (60 light)	333	1155	470	456	"
Western Elec.	263	355	186	220	"
Thomson-Houston.	227	1030	425	388	L. B. Marks.
" "	222	626	288	267	"
" "	382	1131	625	474	"
Weston	594	1183	514	593	"
"	475	871	400	436	"

TABLE 27.

Observed and Calculated Efficiencies.

Carbon.	Horizon Effic.	Max. Effic.	Spherical Effic. observed.	Spherical Effic calculated.
.832 inch.	1.82%	9.00%	6.87%	5.60%
.563 "	4.12%	14.41%	11.00%	11.83%
.500 "	4.91%	17.33%	12.66%	14.22%
.450 "	5.48%	15.52%	13.30%	13.01%
.370 "	5.55%	17.50%	15.54%	14.51%
250 "	8.44%	19.30%	16.60%	16.96%
A molded high ten.	5.53%	16.21%	11.71%	13.53%
D forced "	4.42%	12.57%	10.01%	10.53%
B (unplated) "	8.89%	13.52%	12.69%	12.37%
B (plated) "	9.91%	13.69%	12.72%	12.75%
E molded "	2.33%	11.05%	8.96%	8.37%
E forced "	2.28%	8.95%	7.76%	7.29%
A forced low ten.	5.42%	13.51%	11.05%	12.68%
B molded "	5.69%	12.73%	9.32%	10.96%

TABLE 28.

Length of Arc: Constant Potential.

Carbon.	Current amp.	P. D. volts	Length of arc; inches.
E. molded high tension.	6	50	.087
" "	7	"	.114
" "	8	"	.137
" "	9	"	.147
" "	10	"	.150
" "	11	"	.154
" "	12	"	.156
" "	13	"	.167

TABLE 29.

Length of Arc: Constant Current.

Carbon.	Current amp.	P. D. volts	Length of arc; inches.
E. molded high tension.	10	40	.073
" "	"	45	.095
" "	"	50	.141
" "	"	55	186
" "	"	60	.216

[12] When the carbon is impure and contains a large amount of silica, the latter is often deposited in the form of a glass bead on the point of the negative pencil. The "mushroom" alluded to in the text, does not refer to this deposition.

[13] O. G. Pritchard: Electric Arc Light Carbons. London Elec. March 21st and April 4th, 1890.

[14] E. E. Peck of Brooklyn, N. Y.; Carbon Tests—paper read before National Elect. Light Assoc'n, Kansas City Convention, Feb., 1890.

Note on A New Photometer.

by edward l. nichols.

Methods of photometry, which take no cognizance of differences of quality, are so ill adapted to the study of sources of light which differ from each other widely in temperature, that the introduction of some instrument by means of which both the character and intensity of an illuminant can be readily determined, would be a desirable adjunct to the equipment of our photometer rooms.

The instrument which it is my purpose to describe, has been designed to meet this need. Existing types of the spectrophotometer may be made to give good results, but they are expensive instruments, and so difficult to use that it is only in the hands of observers of considerable experience that accuracy is assured.

The new apparatus, the "horizontal slit" photometer, is, in point of fact, a spectrophotometer, in which the polarizing device is entirely done away with. In it the extremely simple principle of the Bunsen photometer is applied successively to the various regions of the visible spectra of the source of light which are to be compared. A direct vision spectroscope of Browning's form is attached to the usual car of a Bunsen photometer, from which the disk and mirrors have been removed. The optical axis of the collimator is horizontal and at right angles to the photometer bar. The slit is horizontal and lies in a straight line joining the sources of light, which are set up in the usual manner at the ends of the bar. The bar itself is preferably of considerable length—in the case of the one upon which the original instrument under consideration was mounted it was 500 c. m. long—and should be divided into 1,000 equal parts.

In front of the spectroscope slit are placed two right angled prisms of the same size, and made of the same glass, (see cut). Their vertical adjacent edges bisect the slit, and light traveling from either end of the photometer bar is totally reflected by them, and enters the right and left hand end of the slit in a direction parallel to the optical axis of the collimator tube.

The two sets of rays thus gathered into the spectroscope from the lights at the end of the bar are vertically dispersed by the Amici prisms, and appear in the field of view as two vertical spectra standing side by side. Equal wave lengths are in the same horizontal line, and any desired region may be brought into the center of the field by an angular movement of the occular telescope. The telescope moves along the arc of a suitably divided semicircle, to which it may be clamped by means of a set screw. Wave lengths, corresponding to the various circle settings, are determined once for all by observation of the more prominent of the Fraunhofer lines.

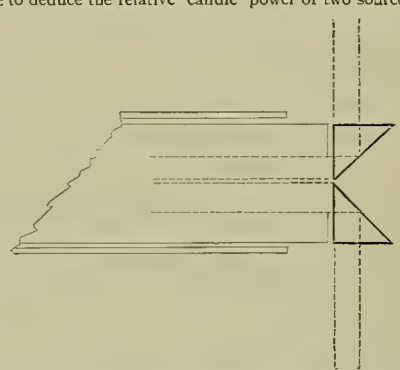
When the instrument thus mounted is placed at the middle of the photometer bar between lamps which are identical in intensity and quality, the two spectra are of equal brightness throughout, wave length for wave length, from red to violet. If the two lamps differ in intensity but not in quality, the two spectra will differ in brightness by the same amount from end to end, and a position may be found upon the bar for which they will be identical throughout.

Under these circumstances, which are the only ones in which the Bunsen method in photometry is strictly applicable, the instrument may be used as a simple photometer, the setting for any wave length whatever giving the candle power. For this purpose alone, viz., for the comparison of lights of similar character, the instrument offers certain manifest advantages over the various forms of the Bunsen photometer. In the course of the present paper I shall present some definite data concerning the relative sensitiveness of the two instruments when used in this way.

When the lights to be compared differ both in intensity and quality, ordinary photometric indications possess no perfectly definite significance. In this, which is the more general case, the relative brightness of the spectra of the two sources varies with the wave length. For each region of the visible spectrum, however, a position upon the photometer bar can be found at which the brightness of the two spectra in that region will be equal, and the observations thus obtained, when extended over the entire spectrum, will afford data by means of which the differences in quality of the two sources of light may be definitely expressed.

In a recent paper read before the Institute (Transactions of the American Institute of Electrical Engineers, Vol. 6, p 183), for a considerable range of temperature at least, the ratio between the intensities of a certain wave-length of the spectrum of glowing carbon, is identical with the ratio of candle powers, as determined by the Bunsen photometer. The wave length in question, determined from the intensity of the spectrum of incandescent lamps at various candle powers, I had found to be approximately $\lambda = 600$. M. A. Crova, in an important paper since presented at the late electrical congress at Paris,[1] has pointed out the importance of this method of measuring the light from sources differing in temperature. The wave length which he has indicated for this purpose is $\lambda = 582$, which belongs to a region lying slightly farther toward the green than the one which I had adopted.

When the wave length of this region has been established beyond question, the photometry of lights which vary in color, will have been reduced to a definite scientific basis. Instead of attempting to use the Bunsen photometer in measurements to which it is not adapted, we shall be able to deduce the relative candle power of two sources of



light from the comparison of a single wave length, and we shall be freed from the uncertainty arising from differences of color and from the personal errors due to the independent use of the two eyes in observation. The determination of candle power will then be an operation of precision, even when the sources of light to be compared vary widely in temperature. It is in the opportunity of performing such observations upon the photometer bar itself, under conditions which do away with many of the sources of error inherent in the usual methods of spectrophotometry, that the chief advantage of the new photometer will be found to lie.

The following set of observations, taken with the new instrument, may serve to indicate one of the uses to which it may be put. The data are taken from an investigation now in progress in the physical laboratory of Cornell university. The object in view was to compare the spectrum of a novel type of gas burner with that of an ordinary argand burner. The two lamps were set up at the ends of a photometer bar five meters long, the bar, as already stated, being divided into 1,000 equal parts. Readings were taken at six points in the spectrum. The purposes being to express the relative brightness of the two spectra, wave length for wave length; the intensity of that due to the argand burner was taken as unity throughout, and the brightness of each region of the spectrum of the flame under investigation was obtained in terms of that of the corresponding region of the spectrum of the argand. The results are given in table 1:

Table I.

Comparison of the spectrum of a Welsbach burner with that of an ordinary argand burner by means of the "horizontal-slit photometer."

Color.	Wave-length.	Light ratio, Welsbach / Argand.	Probable error of a single observation.
Red	702	0.709 ± .017	2.45 per cent.
Yellow	589	1.476 ± .017	1.14 "
	558	1.760 ± .023	1.34 "
Green	500	2.395 ± .047	1.99 "
Blue	466	2.738 ± .036	1.30 "
Violet	439	3.090 ± .073	2.35 "
			1.76 " (Average.)

From observations by Miss Ida M. Hill.

Ten observations were made in each region.

[1] M. A. Crova, La Lumiere Electrique, vol. 33, p. 478.

(*Continued on page* 303.)

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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A LARGE portion of the present issue of the WESTERN ELECTRICIAN is devoted to the presentation of papers read at the general meeting of the American Institute of Electrical Engineers. The meeting was perhaps the most important ever held by the society, and the papers are of a high order of merit. The topics treated are in the main subjects of great interest in the electrical world at the present time. Mention of several of the papers is made in succeeding paragraphs. Prof. W. A. Anthony was elected president for the ensuing year. Under his administration the society will maintain the splendid standing it has gained under Prof. Thomson's able leadership.

THOMAS D. LOCKWOOD'S paper on "The Industrial Utilization of the Counter Electromotive force of Self-Induction" bears evidence of the author's elaborate researches, and study of the subject, and the care exercised in the preparation of the article. Mr. Lockwood has succeeded in compiling a vast amount of information on this subject, and he has presented it in a simple and attractive form. In view of the fact that Prof. Henry was the first to study and discuss self-induction, it is generally believed that he was the first to notice its effects, and it is to correct this false impression and furnish historical proof of its inaccuracy that Mr. Lockwood calls attention to the fact that an experimentalist, Vassali Eandi, published in the *Philosophical Magazine* in 1803, the discovery of this phenomenon. To Prof. Henry, however, belongs the credit of mastering the subject and presenting the first analytical notice of the electromotive force of self-induction. Beginning at this point Mr. Lockwood records the results of the investigation on this subject down to the present day. The paper is especially valuable from a historic standpoint.

A PAPER of more than ordinary interest by Wilfrid H. Fleming, was read at the general meeting of the American Institute of Electrical Engineers. His topic was "Electric Lighting in the Tropics." The incandescent lamp is extremely popular in warm countries, he explains, for manifest reasons. The fact that it does not cause the temperature of any apartment to rise to any appreciable extent, of course constitutes a powerful argument in its favor in countries where the heat is intense. Electric light companies are reaching the conclusion that tropical countries will prove eventually an excellent market for their apparatus. For this reason Mr. Fleming's summary of many of the difficulties to be encountered in installing plants and of means of overcoming them, will be read with interest.

THE last effort to save the murderer, Kemmler, and have the electrical execution law pronounced unconstitutional by the Supreme Court of the United States, has failed. The motion for a writ of error was argued at Washington last week and was denied, Chief-Justice Fuller presenting the opinion. It was held by the court that inasmuch as the legislature of the state of New York in substituting electricity for the rope had been guided by a desire to lessen the brutality of the proceeding, and as the system adopted was favored by a commission specially appointed for the purpose of learning the most humane method of inflicting the death penalty, it was to be presumed that the legislature acted intelligently in the matter. This assumption, however, will be considered unwarrantable by those who are best acquainted with the proceedings of that unique body of solons. So far as the right of the legislature to change the mode of inflicting the death penalty is concerned, the court holds that the legislature did not overstep the bounds. It is claimed that another effort will be made to secure a review of other points involved in this interesting case.

"THE applications of electricity in the navy have always been on the increase," says Gilbert Wilkes in the course of his paper before the American Institute of Electrical Engineers, published in another column. There are reasons for the popularity of the many forms of application of electricity on shipboard, and as Mr. Wilkes remarks: "Any one who has served one cruise with oil lamps and another with electric light and motors, will understand the favor in which the increasing use of electricity is held by the naval men." The requirements of an electrical plant for naval work are concisely presented; an ideal plant, filling all these requirements, is described, but Mr. Wilkes says it is not to be found to-day. Many of the systems possess numerous points of advantage, but in each, according to Mr. Wilkes, there are likewise shortcomings—in a word, an ideal plant for naval uses is yet to be presented. Many of the features which Mr. Wilkes describes as essential to a plant of this character are, it may be said, desirable in all installations, but he particularly insists upon several important conditions. In the first place, it is considered necessary that the dynamo should be driven direct, that the plant should be compact and light, and that the machines should be proof against the injurious effects of salt water, and "not subject to mechanical damage." The reasons for these requirements are obvious. In torpedo work the most important features of the dynamo are compact form and lightness. The advantages of electric motors for ship work have already been recognized, and it is said "It may not be long before motors may look for a larger field on board ship." Many small engines are now in use on a man-of-war that might be advantageously replaced by motors. "One electrical application," he says, "that presents many advantages on board a man-of-war, especially when in a foreign station, is electrical welding. * * * Welding machines have not yet been actually used on shipboard, but it is to be hoped that their introduction is a development of the near future." The paper contains many interesting details, and will repay a careful perusal.

AMONG the papers read at the general meeting of the American Institute of Electrical Engineers was one by O. T. Crosby on "The Limitations of Steam and Electricity in Transportation." Mr. Crosby treats his subject with a thoroughness which can only be appreciated after a study of the paper. The paper is replete with calculations and tables, and it is evident that the writer's aim was to handle his subject in the light of facts. A perusal of the paper can but give the reader the impression that Mr. Crosby is thoroughly familiar with the best practice in steam as well as electrical engineering. In considering the capacity of the electric locomotive to haul any given load, Mr. Crosby again calls attention to the fact, already referred to in another paper by the same author, that "the adhesion coefficient seems not increased in any practical degree by the mere passage of the current from wheel to rail." In this connection it is to be noted that considerable data are presented as to the dead weight necessary for hauling a ton at different speeds. Bearing in mind the fact of the relative lightness of the electric locomotive as compared with the steam locomotive, a fact which the majority of writers on the subject seem to have ignored, the value of the various data presented will be appreciated. The author concludes that a slow-speed armature placed on the car axle would place the electric motor in the lead at all service speeds, and also, that for speeds above 70 miles per hour an electric motor of 90 per cent. efficiency working through gearing of 90 per cent. efficiency would prove more economical than the steam locomotive, save in cases of very infrequent service on very long lines.

CARBON manufacturers, aiming to produce an article of a high standard of excellence, might peruse with profit L. B. Marks' paper on the "Life and Efficiency of Arc Light Carbons." The writer states that the investigations which he describes were undertaken with a view of studying the action of modern carbon pencils. The greater part of the research was upon the life and efficiency of carbons, and the pencils experimented upon were all of American manufacture. It will be noted in this connection that the names of the several brands tested are withheld. This is to be regretted. While the tests were apparently most thorough, and from a scientific point of view exceedingly interesting, they are practically valueless. Under the head of life tests, it is stated that: "If a carbon is burned with a small current, its life will be long, at a sacrifice of life-giving properties. If, on the other hand, a large current is used, there may be a gain in efficiency at a sacrifice of life. The question arises—what is the proper current to use?" A hypercritical electric light man might wonder at the writer's reason for considering the question of adapting the current to the carbon when the carbon, as a rule, is purchased to be used with a given constant current. The investigator found that the life of a carbon varies directly with its diameter, and inversely with its resistance. In considering the efficiencies Mr. Marks notes "that relative high efficiency in a forced high tension carbon is obtained only at the expense of life; that a moulded carbon is, generally speaking, superior to a forced for high tension and vice versa for low tension." He also points out that while the life of a copper plated carbon is greater than that of an unplated carbon, the mean spherical efficiency appears to be the same for both. The record of candle power tests substantiates Prof. Nichols in the opinion that methods of photometry, which take no cognizance of difference of quality are ill adapted to the study of sources of light differing from each other widely in temperature."

(*Continued from page* 301.)

I introduce these measurements here simply as an illustration of one line of work to which the instrument under consideration is adapted. A full description of the research of which they form a part, and which covers many other questions pertaining to the very interesting class of lamps with which it deals, will doubtless be published in due time

As will be seen from the column of probable errors the sensitiveness of the instrument is greatest in the region of the *D* line ($\lambda = 589$), and least in the extreme red and violet, where the light intensities are small

A set of ten determinations made by the same observer with the Bunsen photometer gave for the total light ratio of the two lamps:

$$\frac{\text{Welsbach}}{\text{Argand}} = 1.701 \pm .015$$

The probable error of a single observation in this series amounted to 0.89 per cent., a value somewhat smaller than that obtained with the new photometer in the yellow of the spectrum.

The number of observations is too small to afford a close estimate of the relative sensitiveness of the two instruments, but the results suffice to show that the "horizontal-slit" photometer does not differ appreciably in accuracy from the Bunsen photometer when the latter is used in the comparison of flames of the same color.

When it comes to the measurement of sources of light that differ widely in temperature the comparison is decidedly in favor of the "horizontal slit" photometer, the sensitiveness of which is not affected by differences of color. The error of the Bunsen photometer in candle power measurement of the arc light, for instance, calculated from ten observations recently made upon the same photometer bar, the reference standard being an argand gas burner, was 2.65 per cent. (probable error of a single observation), a value more than twice as large as that of the "horizontal-slit" photometer.

A comparison of the performance of the new photometer with that of a polarizing spectrophotometer of the type which is commonly recognized as affording the highest degree of accuracy, is decidedly in favor of the former. Taking as a basis eight observations made by Mr. Franklin and myself in the study of a bat's-wing gas burner,[1] the observations covering eight regions of the spectrum, I find the error of a single observation in the various regions to have been as follows:

TABLE II.

Probable errors of a single observation with a polarizing spectrophotometer, calculated from sets of ten observations upon various portions of the spectrum of a gas flame.

Wave lengths.	Probable error of a single observation.
753	7.9 per cent.
668	4.9 " "
608	4.5 " "
557	5.4 " "
518	6.4 " "
492	7.0 " "
468	3.0 " "
450	2.4 " "
	5.2 per cent. (average.)

The measurement of a fluctuating illuminant, such as the gas flame, is a line of investigation by no means adapted to exhibit any photometric instrument at its best; but as the errors of the horizontal-slit photometer, already given, were calculated from sets of ten observations upon such flames, I have selected for comparison similar sets of ten upon sources of the same character.

The averages: viz.:

Error of horizontal-slit photometer 1.76 per cent. (average for spectrum.) Error of polarizing spectrophotometer 5.20 per cent. (Average for spectrum.) doubtless afford a fair indication of the relative performance of the two instruments in this peculiarly trying line of work.

At the last annual meeting of the institute I had the privilege of presenting a brief study of certain personal errors pertaining to the use of the Bunsen photometer. The particular class of errors to which attention was called in that paper are undoubtedly obviated by the use of the horizontal-slit photometer; what new ones the latter instrument may introduce remains to be determined.

Papers on the "Practical Aspects of Alternating Current Theory," by Dr Michael I. Pupin, of New York, and "Automatic Welding Machines," by Herman Lemp, Jr., were also presented. In the absence of Thos. D. Lockwood of Boston, his paper on the "Industrial Utilization of the Counter Electromotive Force of Self-Induction" was read by the secretary, R. W. Pope, as follows:

THE INDUSTRIAL UTILIZATION OF THE COUNTER ELECTROMOTIVE FORCE OF SELF INDUCTION.

BY THOMAS D. LOCKWOOD.

It may as well be confessed at the outset that, although my production has cost me considerable thought, it does not claim to advance any original ideas. Its claims to attention are based solely upon its merits as a chronicle. There seems to be among the modern race of electricians not a few who regard that species of counter-electromotive force which is the subject of this paper, as being the only species in the genus. While of course this view is erroneous, it is easily accounted for by the notorious fact that the American electricians as a class have little time to study. The fact, however, while it is indeed as I have termed it, "notorious," is still to be deplored; for it is certain that were electricians fully informed not only of the researches which took place before their own, together with the results of the said researches, whether these results took the form of success or failure, there would be much less valuable time wasted in supposed original research; there would be far fewer valueless inventions produced; and there would be a much smaller amount of subsequent vexatious and useless litigation.

While counter-electromotive force generally speaking, is a genus; the counter electromotive force of self-induction is a species, and while an illustration of this statement will no doubt to most of us be an operation something in the nature of carrying coals to Newcastle, or water to the Mississippi valley, I cannot believe that it will be a waste of time, since doubtless we have many members who have not fully considered the subject.

Consider for a moment a definition of electromotive force. What shall we say it is? It certainly is not a natural force like gravitation, and I do not think we can do better than concede that we call it a force, simply because it is convenient so to do; and define it as any agency tending to set up that form of motion or vibration which we call electricity; or if you please, any agency tending to the manifestation of electricity.

We are constantly hearing that a current of electricity is the result of a difference of potential between two points connected by a conductor, but though this statement through constant repetition has come to be as it were "human nature's daily food;" I am inclined to consider it as being after all but a mathematical way of saying that a current of electricity is the necessary result of an electromotive force provided with a closed conducting circuit. For it is the electromotive force which first determines the difference of potential, which therefore may be considered as being a kind of initial result. Following out this train of thought, it appears then that electromotive force is a function of the source or instrumentality which develops the current, and expresses the totality of difference of potential in the entire circuit; and while we may properly speak of the difference of potential, or fall of potential between any two points on the circuit, I think we can not with equal propriety speak of the e. m. f., in any other way than as something pertaining to the source.

And further consideration of the same idea, shows the incorrectness of the popular phrase often used of late years even by many eminent and able electricians, "a current of so many volts," the electromotive force being in no sense, near or remote, an attribute of the current.

To run counter to anything, is to run against it, to run in opposition to; to act opposedly; and so a "counter electromotive force" may be defined as any agency tending to develop a current of electricity in a circuit, opposite in direction to that of the current excited therein by the initial electromotive force.

A familiar instance is that of connecting up in an electric circuit a certain number of cells in opposition to a number of other cells. This constitutes a primary counter-electromotive force and its inclusion in the circuit reduces the current in two ways; first, by reducing the acting electromotive force to a value equal only to the algebraic sum of two opposing forces; and secondly, by adding internal resistance of the value of the cells added in opposition.

Another familiar illustration is found in that ingenious class of dynamo regulator, which acts by causing the opposing brushes to creep around the commutator and according to the work which is being done in the external circuit, to include in the circuit (by increasing or decreasing the lead of the brushes) a greater or less number of armature coil sections exerting an elect omotive force in opposition to the electromotive force which is developing the working current.

In these cases a utilization is made of counter electromotive forces deliberately organized for the purpose, but they are not counter-electromotive forces due to self-induction.

At a very early period in the history of voltaic electricity it was discovered that there was some deteriorating force at work in every voltaic battery which depreciated the current to a much greater extent than exhaustion of the liquids or consumption of the solid elements could account for; and in 1801, Gautherot found[1] in this phenomenon which has foolishly been called "polarization," the germ of the secondary cell. He discovered that wires of platinum or of silver which had been used to decompose salt water acquired a power of themselves yielding a current when placed in acidulated water and could cause muscular contractions of a frog's leg and produce the galvanic test. And subsequently it was ascertained that the operation of a voltaic battery tended to coat the negative plate with hydrogen which tended to set up a counter-electromotive force between the hydrogen and the surface of said plate, which thus reduced the available energy of the battery, and that this action could be transferred to the electrodes of the same battery, if placed in a separate decomposing cell, and there tended to form electrically opposed surfaces which could themselves be used to develop a current in a direction opposite to that of the original current. As we all know, this operation, long regarded only as an unmitigated evil, is now utilized in the formation and operation of cells adapted for the electrical storage of energy.

The counter-electromotive force of self-induction distinct from the foregoing, is that discovered by Professor Henry; and its most important use is that which has been mainly brought out in association with the employment of alternating or other currents for the purpose of regulation. By reason of the fact that this utilization has proved to be overwhelmingly important, the electrical fraternity has partially lost sight of many earlier and contemporary instances of the useful employment of self-inductive electromotive force; which is indeed a close analogue in its character, mode of generation, and capabilities of use in regulation to that developed and utilized in the operation of electromotors.

Firstly—I desire to point out that though Henry was the first to study and discuss self-induction, he was not the first to notice its effects.

Until quite recently I, together with nearly every one else, had supposed that the earliest published notice of this phenomenon was Henry's account[2] of his observation, published in 1832; but I have in my researches on the subject dug out the fact that this is not so. I find that an experimentalist, Vassali-Eandi by name, records that[3] with a pole of fifty pairs he found that the fluid passed along a copper wire plated with silver, 1,151 feet in length, in a time incommensurable; the shock in this case was three times as strong as that experienced by immediately touching the two extremities of the pile.

The above isolated statement of facts stands I believe alone, and there is no record that it led to further research.

Henry on the contrary perseveringly pursued, and made himself master of the subject; and the record of his original observation, brief though it is, details the appearance of a vivid spark on the breaking of a battery circuit, if a wire thirty or forty feet in length be included in that circuit; shows that the effect is increased by coiling the insulated wire into a helix; and that the effect depends in some measure on the length and thickness of the wire. The note concludes with these remarkable words: "I can account for these phenomena only by supposing the long wire to become charged with electricity, which by its reaction on itself projects a spark when the connection is broken."

This, though brief, is then the first analytical notice of the electromotive force of self-induction, so long erroneously demominated after its result, the "extra current."

It is unfortunate that Prof. Henry did not for some time pursue the subject, and we do not hear from him again until March, 1835.

Meanwhile his great contemporary, Faraday, had taken it up pursuant to an observation of one William Jenkin, and showed self-induction to be a corollary of his former masterly experimental researches in magneto-electro induction.

Faraday notes[4] the following points: "Self-induction exists in simply helices as well as in electro-magnets, though not to the same degree.

Helices are superior in developing induction to straight wires, and long wires to short ones.

Self-induction practically disappears when the conductor is permitted to inductively act upon a neighboring closed circuit.

That the amount of self-induction depends on the length of wire exposed to inductive action.

An iron core within helices much exalts the action of self-induction.

The self-inductive effect depends not "upon a permanent state of the core, but on a change of state."

Henry now again takes the matter, and in a consecutive series of papers, practically runs it to earth.

In a paper[5] of March, 1835, he gives more in detail some of the conditions of the development of self-induction. A long wire is better than a short one; a helix better than a straight wire of equal length. He also describes a shocking coil, and also a deflagration coil of but one wire in which self-induction is involved.

A little later[6] he elucidates the origin and properties of self-induction, and records that some additional energy appeared when iron was used as a core, but not much, because his coils were flat, and not elongated helices. He ascribes all of these effects to dynamical induction, and shows that in a coil of a number of convolutions the convolutions act inductively on each other, and inferentially that the energy of the self-induction is the sum of that of the different coils.

In a third paper[7] further experiments in self-induction or with the extra current, as it was then called, are discussed. We learn that the electromotive force of any self-induction coil within certain limits is dependent upon the length of the coil.

That the form of the coil has considerable influence on the intensity of the action. In the experiments of Dr. Faraday, a long cylindrical coil of thick copper wire inclosing a rod of soft iron, was used.

This form produces the greatest effect when magnetic reaction is employed.

The "extra current of self induction developed in a coil is controllable by the presence of an immediately adjacent independent coil. It is energetic when the circuit of the adjacent coil is open but absent when the adjacent circuit is closed."

Of course it is impossible in this paper even to indicate the many good things which are spread before the reader of the researches of both Faraday and Henry. They are well worth study, and in fact they laid a solid foundation for the work which is being done now.

Both discovery and invention are displayed in their work, much of which has only found its sphere of action within the last four years; for it is emphatically true as has been said by Mr. W. H. Preece, "that though we are accustomed to hear that necessity is the mother of invention, the child is, as a matter of fact, often born before its parent."

As is frequently the case with electrical discovery, self-

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1 American Journal of Science, Vol. 38, p 100 See also Transactions of the American Institute of Electrical Engineers, Vol. 6, p. 177.

Transactions of the American Institute of Electrical Engineers, Vol. 6, p. 335.

1 See Izarn's Manual du Galvanisme, Paris, 1804, and Phil. Mag. 1806, Vol., XXIV. p. 185.

2. Silliman's American Journal of Science, July, 1832, Vol. XXII, pp. 403-8

3. Philosophical Magazine, Vol. XV. 1803; also Phil. Magazine Vol III, 4th ser. 1852, p. 455.

4. Experimental Researches in Electricity. Faraday, 1849. Vol. Ninth series pp. 332-343, read before the Royal Society, January 29. 1835 A series of notes "The Influence by Induction of an electric current on itself."

5. Journal of the Franklin Institute, March, 1835 Vol. XV. pp. 169-170, Silliman's American Journal of Science, July. 1836. Vol. XXVIII, pp. 327 and 331 and Scientific Writings of J. Henry, Washington, Vol. I, pp 87-91.

6. Transactions American Phil. Soc. N. S., Vol. V., pp. 223-231, reprinted in Sci. Writings, J. Henry, Washington, 1889, Vol. I, pp 92-100.

7. Transactions of American Phil. Soc, Vol. VI., pp. 303-337, Nov. 2, 1838

Silliman's American Journal of Science, March, 1840, Vol. 38, pp. 209-243.

Scient. Writings of Joseph Henry, Washington, 1886, Vol. I, p. 108.

induction was long recognized, that is, for the most part, and by the generality of electricians only as an unwelcome guest whose parting was to be speeded

It was manifested mainly by an undesirable spark appearing upon the break of electric circuits in telegraphic, scientific and medical apparatus, and tending to burn away or oxidize, contact points; while in the case of the two wire induction coils its effect was to reduce the spark passing between the terminals of the secondary; and many have been the expedients, wise and otherwise, which were devised for its banishment. Many of these were patented; more were not; inasmuch as the fever for patenting everything from a solar system to a thought, had not then come into fashion.

Examples of this class of expedient are respectively:

British Patent No. 12,772, September 20, 1849, granted to those old heroes of electric lighting history, Staite and Petrie, which had for its 15th clause a mode of "preventing the spark when breaking contact in galvanic circuits. A thin platinum wire may still convey some portion of the current after the main circuit is broken, or a series of sufficiently long conductors may break contact, one after the other." The preferred way, in plain English, was to connect a fine wire as a shunt round the break, and thus to furnish a closed circuit in which the self-induction circulated its current of breaking.

United States Patent No. 33,269, granted to J. E. Smith, September 10, 1861, for a means of preventing the spark between the local points of a relay on breaking the circuit; shunting the break by a wire having two terminals dipping into a bottle of water.

Moreover, as is well-known in the ordinary induction coil the action is emphasized by shunting the primary break by a condenser as first suggested by Fizeau[8]. This, as I shall point out later, is a real instance of the industrial utilization of self-induction.

Other early investigators in this line reduced the spark of breaking the circuit by wire shunts also.

Although as I have stated, the recognitions of self induction were mostly recognitions of an adversary, there were one or two early instances where the enemy was subjugated, and made to expend his energy usefully. The most notable instances of this are the single wire spark coils of Page and Callan[9] which were made especially with a view to exalt the self-inductive effects and with which metals were fused, and electrolytes were decomposed.

These were the forerunners of the spark coils used at the present day in electric gas lighting and comprising a single long coil wound to a suitable length upon a long core of iron wires.

There can, however, be no doubt that the principal attempts to make useful the counter-electromotive force of self-induction, and likewise the principal successes achieved, have been in the line of controlling, regulating or modifying the original, initiatory, or primary currents from which it has been developed.

I have compared this to the transposition of a given number of battery cells.

This analogy is, however, imperfect, since in cells of battery we may for the sake of argument regard the e. m. f. as being practically constant. Certainly they will in no sense regulate themselves in accordance with conditions automatically, but the inductive resistance will do this. For it is dependent for its efficiency as a generator upon the strength of current flowing through it. Therefore, if the current through it due to the impressed electromotive force from any reason falls, the counter-electromotive force will also diminish, and thus will permit a greater amount of the initial force to act; or in other words, will permit the impressed energy to become more effective. Suppose we have in the main circuit of an alternating dynamo, supplying a number of incandescent lamps in bridges uniting its mains, an adjustable resistance; and suppose the inductive resistance, which we may also regard as a counter e. m. f. generator, to be initially adjusted, so that all of the lamps burn brightly; then within limits of considerable range the current will be kept steady even though the applied e m. f. fall or rise, or though the external resistance of the circuit be varied by lighting or extinguishing lamps.

For if lamps be extinguished and their branch circuits be opened, the external resistance rises, and the current falls. It is true that the reduced current has not now so many branches to divide through, and that therefore self-regulation even without counter e. m. f., might be expected but in systems of considerable magnitude it is not found to act practically, as well as it theoretically should. But here the useful effect of our self-induction regulation comes into play; and since the current acting upon the regulator is lowered, it is caused to develop a counter e. m. f. of less value, and thus to oppose less energetically the applied e. m. f., which therefore is brought to a greater extent into action to overcome the increased resistance, and to maintain the normal current for the remaining work. So, if the applied potential falls, the current in consequence falls with it, and the counter e. m. f. developed falls also, and enables more of the applied e. m. f. to come into action. And the converse is true, if the current in the circuit from any other cause rises. Such an appliance would be still more convenient in connection with an arrangement of arc lamps fed by alternating currents, and connected up in parallel circuit, since the resistance of arc lamps would constantly be changing.

This has been so prominently brought before us by its most modern improvement, namely by its well-nigh involuntary use in the distribution of electricity by means of alternating currents and transformers or converters having their primaries connected in parallel between the two mains of the source; and by the inductive resistance regulating device, patented by John Hopkinson, in England, August 3, 1881, No 3,362; and in the United States, November 5, 1889, No. 414,541, that many persons have actually been led to believe that such use is really a new thing.

8. Comptes Rendus, Vol. XXXVI. p. 418, 1853.
9. Sturgeon's Anoals, Vol. 1, pp. 290–302.

The employment, in the regulation of electrical distribution, of counter-electromotive forces set up by the working currents themselves and proportioning themselves automatically to the work being done, is one of the most valuable and interesting features of modern electrical work; and, though such regulation requires to be supplemented by auxiliary arrangements and though the belief of some that it could be attained absolutely without any waste has not been completely realized, still, by availing ourselves of this feature we are enabled to control electricity with a facility and under conditions which otherwise would be unattainable.

The Hopkinson invention consisted in associating with an arc or glow electric light circuit employing alternating currents, a variable inductive resistance. This in one form was made by coiling a ribbon of thin sheet iron into a ring form, the different layers being separated by an insulating layer, and then by winding a number of coils of insulated wire on this ring, their adjacent ends being connected with plates between which contact plugs could be inserted, so that any number of the coils could be introduced or cut out from the circuit. Another form embodied the same principles, but had not a closed core. This form had a horseshoe core made of an electro-magnet formed of layers of sheet iron insulated from each other. The legs of the core are surrounded with the coils, and the said core has an armature also made of insulated layers of sheet iron. In this form the armature is clamped down; but the regulability of the appliance is attained by moving the magnet core further into or withdrawing to a greater or less extent from the surrounding coils. The form first described, is in the British Patent shown as being included in circuit with the two mains of a dynamo; incandescing lamps being in cross bridges between the said mains; while in another figure arc lamps are in parallel circuit with mains, an inductive resistance being included in each branch for each lamp, and acting as an equalizer.

The iron core closed on itself to form a complete magnetic ring in which the lines of force are concentrated through the coil, and forced to cut all convolutions when exposed to reversals; the laminations at right angles to the currents, acting to facilitate magnetic change, to diminish hysteresis, and to prevent the circulation of eddy currents; and the insulation of the said laminations aiding in the latter function; all tend to show that this is a very highly organized appliance, and is not only well adapted to produce a very high degree of self-induction, but combines most of the best arrangements tending to that end, and it is therefore not surprising that this invention and use made a strong impression upon the electrical mind, and caused a revival of the idea that regulation on these lines was capable of being accomplished, to use the words of the patent, "without wasting energy." Without materially wasting energy would perhaps be more strictly accurate, for by its use a small amount of actual resistance coil is enabled to do the work of a very much larger amount.

I have certainly no desire to detract from the great merit of this application, but an honest chronicler has no choice and must say what has been done, and it must therefore be stated that inductive resistance and other self induction appliances had long been used both experimentally and commercially; no doubt often with but an imperfect conception of their mode of operation.

Poggendorff's[10] researches into the action of induction coils disclose a remarkable state of affairs for so early a date. These show that one induction coil was employed to send a current through the secondary helices of two others. The first coil thus acted as an alternating generator, and the two others as inductive resistances.

The primaries of two induction coils were connected in parallel, and also in series at different times When, to quote Poggendorff's own words: "Two instruments (induction coils) *A* and *B*, were so combined that the current traversed the two primary coils one after the other, the induction coils (secondaries) however were separated and *A* was allowed to give sparks, whilst *B* remained unclosed and without a soft iron core; the introduction of the latter into *B*, weakened the sparks of *A*, and the subsequent metallic closing of *B* reproduced their former strength."

The proper arrangement of induction coils is then discussed and whether the primaries should be connected in series or in parallel circuit. It is shown that the latter way is the proper one, and why. Then the paper goes on to say: "With respect to the cause of these phenomena it is no doubt to be sought in the extra or inner induction current The outer induction current which is produced by breaking the inducing current, has the same direction as the latter, whereas the extra current which is at the same time excited in the induction wire, whose tendency is to weaken the first induction current, and the more so the stronger the extra current, which latter is especially strengthened by the soft iron core

"Consequently when the primary coils of *A* and *B* are connected one after the other, it is clear that the insertion of the soft iron core into that of *B*, will strengthen the extra current in that of *A*, and therefore weaken the induction current of the latter instrument

"By connecting the instruments side by side a closed circle is at once formed by them, and the extra current produced by the insertion of the soft iron core into *B* acts against that in *A*, and may therefore, when both are equal, completely neutralize it, when the outer induction current of *A* will necessarily be strengthened.

"Without the circle formed by this combination, *i. e*, in the wire leading back to the voltaic battery, the two extra currents act, of course, in the same direction and strengthen one another, in consequence of which the sparks at the current breaker are still very active"

These considerations of Poggendorff, show that even at this early period a great flash of light was thrown into the darkness which hitherto had obscured the reactions of self-induction, and though we have largely failed to use that light until quite recently, this is chiefly attributable to the same oft recurring reason that there was really little call for it; hence it was soon hid under the bushel of the results of research on other subjects of more immediate interest.

The statement which I last quoted brings me again to the application by Fizeau of the condenser as a shunt to the vibratory break, and to its operation.

As shown by Lord Rayleigh[11] the condenser operates by producing electrical oscillations, and in its action the spark at the contact breaker is greatly decreased and the spark between the secondary terminals greatly magnified, because at the break the condenser is virtually an inductive reservoir, being an electrostatic shunt. And being an electrostatic shunt, the energy it momentarily absorbs is returned reversely to the primary circuit, just as in the discharge of a secondary cell, and increases the inductive variation in the secondary circuit during the brief period of time immediately after the break And as the electromotive force in the secondary is thus exalted it is not difficult to see why the condenser increases the sparking distance

As early as Dec. 6, 1862, a patent for cable working, No. 3,453, was taken out by C F. Varley, which describes the use of a self-induction resistance. This patent says: "A second circuit from the cable to the earth independent of the receiving instrument is formed by means of a resistance coil with a large iron core It may be advisable to connect the cable to earth through an induction coil consisting of a large bundle of iron wire, surrounded by a long length of fine wire, the action of which is as follows: On reversing the battery connections the induction plates (condenser) and battery combined, send a short impulse into the cable, which divides; one portion into the cable, the other through the induction coil to the earth. At the first moment the iron of the core opposes the passage of the current, consequently during the first instant of time, nearly the whole force of the current is applied to the cable. As the iron becomes magnetized to its maximum, this opposition ceases, but the plates have been charged in the opposite direction, and there is no longer any current passing from them into the cable to maintain the magnetization of the iron; the demagnetization of which induces a current in the coil, and discharges the cable. In this way each impulse is followed by a short impulse in the opposite direction One of the figures of the patent shows that the wires of the core are made long, and are turned back on all sides over the wire of the coil, so as to entirely encase it. This feature was in conformity with a previous British patent No. 3,059 of 1856. The arrangement, however, clearly shows a use of a self-induction coil as a current controller, and indicates the function of a large iron core.

We next find the counter e. m. f. of self-induction coming into use in connection with fast telegraph systems. Arrangements for its use are shown in the United States Patents granted to Mr. Edison. These are respectively, No. 135,531 of February 4, 1873; No. 141,773 of August 12, 1873, and No. 147,143 of February 10, 1874.

The first and second disclose a shunt circuit including an electro-magnet connected round the receiving instrument of a chemical telegraph. The first also shows a leak to earth from the line, which leak includes an electro-magnet. In both cases the object is to utilize the discharge current developed by the electro-magnet in the regulation of the operation, and to produce sharp and clear signals.

The third describes the use of electro-magnets in shunt circuits round the transmitting and receiving instruments of an automatic telegraph system and is said to be an improvement on the first. A number of electro-magnets are shown and by means of a switch one or more of these may be introduced. In other words, the inductive resistance is here adjustable, and is operated by breaks, not by reversals.

British Patent No. 3,935, Nov. 14, 1874, to Alexander Melville Clark for a chemical copying telegraph, uses induction and other coils to clear a line by the self-inductive counter e. m. f. By the decrement or cessation of the impulse (as the patent states), the strongest depolarizing effects are produced, and the line is successfully cleared.

Next comes four other patents to Thos. A. Edison. These are U. S. Patent No. 168,243 of Sept. 28, 1875, for an automatic telegraph. This, as in the previous case, employs an electro-magnetic shunt.

U. S. Patent No. 168,385 of October 5, 1875, Duplex Telegraph. This is an excellent example of self-inductive regulation. The counter e. m. f. is developed from electro-magnets in a changing electric circuit and the coils have cores closed on themselves.

The next two, No. 173,718 of February 22, 1876, for automatic telegraphy; and No. 178,221, May 30, 1876, Duplex Telegraphy, involve no new principles and are like the preceding ones.

Much information regarding the subject and further examples of its practical application can be found in a particularly able paper[12] on "Shunts," read by William H. Preece before the Society of Telegraph Engineers in 1887. The subject of the counter e. m. f. developed in electro-magnets is discussed, and the increase of the same, when the iron core is endless, is determined and pointed out; a good many instances of the practical uses of the self-induction shunt are described.

U. S. Patent No. 207,724 of September 3, 1878; granted to Thos. A. Edison for a Duplex Telegraph, shows an electro magnetic coil and closed magnetic circuit core placed in each branch of a Wheatstone Bridge duplex telegraph, to counteract by its counter e. m. f. of self induction the discharge of the electro-magnets in the bridge circuit. In Culley's Handbook of Practical Telegraphy, London, 1878, pp. 303 to 304, also pp. 305 and 411, the regulation of currents by inductive resistances is considered.

In the first instance, the counter e. m. f. of an adjustable series of electro-magnetic coils is used to delay the discharge of a condenser in a duplex system. This is closely analogous to the function of the Hopkinson device, and is

10 Poggendorff's Annalen, Vol. XCIV., p. 2 and London and Edinburgh and Dublin, Phil. Magazine, 1855, Vol. 10, 4th series pp., 136, 137.

11. Phil. Mag. Vol. XXXIX , p. 428, et seq.
12 Journal of Society of Teleg. Engineers, London, 1877, pp. 40–69.

very suggestive. The reference on page 305 states that "static discharge can be entirely compensated for by the use of an induction coil, or a series of electro magnets instead of a condenser."

U. S. Patent No. 227,039 of April 27, 1880, to Muirhead and Winter, for a Quadruplex Telegraph, describes electro-magnetic shunts for reversing keys and relays, which are to counteract by their discharge electrostatic retardation. The specification says, "The electro-magnets may be of the well known closed horseshoe form, or they may consist of a single rod of soft iron with flanges of soft iron and a cylindrical casing of iron closing over the wire and connecting magnetically flange with flange."

U. S. Patent 231,904, September 7, 1880, to Joseph E. Fenn, Duplex Telegraph, uses an electro-magnetic generator of counter e. m. f. in the line circuit to counteract effects of discharge. It is made with a closed magnetic circuit, a separate coil being on each leg of a multiple pole core, several of these poles are made with yokes and the combined yokes can be made magnetically continuous or discontinuous at will by means of iron plugs which can unite the different sections of core.

A book published in 1880 by Louis Schwendler and entitled, "Instructions for Testing Telegraph Lines, and the Technical Arrangements of Circuits," vol. 2, pp. 144-147, gives a description of an electro-magnetic shunt and its operation It is made like an ordinary electro-magnet, but has an adjustable wedge-shaped armature in contact with the cores This, of course, operates by utilizing the counter e. m. f. of self induction which develops currents that circulate through the shunt, and sharpen the signals.

In telephony also, as in other fast systems, employing rhythmical currents, the counter e. m. f. has by no means been idle. As in telegraphy our early acquaintance with it, was an unpleasant one. Many of the earlier telephone lines connected with a number of stations, and at each station there was, of course, an electro-magnet to operate the call. In some cases this was a telegraph relay, and in other cases a bell magnet. But in either case it was found, as indeed might have been anticipated, that the telephone currents had a decided repugnance to pass through the intervening electro-magnets on their way from one station to the other. To quote the graphic words of one of the patentees of devices intended as remedies for this trouble, it was found that electro-magnets were to a large extent "opaque to telephone currents."

Of course this is due to self-induction. The resistance of the line or the magnet coils had little or nothing to do with it. The convolutions however, had, since it is clear that the electromotive force of the self-induction was proportional within certain limits to the number of convolutions.

The same difficulty appeared also in exchange work where between any two connected lines was interposed an annunciator, to give from either end station a disconnecting signal. Several devices have been suggested for the removal of this difficulty, and some of them have been patented.

Elisha Gray shunts the several interposed magnets by condensers: vide United States Patent, 203,264, of May 7, 1878.

F. W. Jones, attacking the same difficulty, shunts the interposed magnet by a non-inductive resistance controlled by the armature of the signaling magnet See United States Patents, 238,399, of March 1, 1881, and 238,912, of March 15, 1881.

Other devices have also acted to shunt the bell or annunciator magnets in different ways; and still other suggestions have been to surround the iron core with a brass sleeve, or with a closed circuit consisting of one layer of insulated wire; but these last, while certainly reducing the retardation, reduce also the magnetic power of the appliance. And there is no remedy so effectual as the absence of the interposed electro-magnet.

The service rendered by self-induction in telephony, and that which still may be expected, fortunately will probably outweigh the ills which it introduces. In many switch-board installations for metallic circuits, the supervising telephones are looped or bridged across between the two conducting links which unite one of the two metallic circuits with the other, and their self-induction prevents a material loss of current. Where from some condition of the service, such for example as the requirement of supervising both metallic and earth return circuits at the same switch-board it sometimes becomes necessary to bridging the telephones to attach an earth branch to the connecting link on one side of the instruments; in this case it has also been found necessary in practice to place coils containing iron cores on the other side of the earth branch, so that not only the resistance but also the self-induction may be balanced.

It has also been ascertained that many telephones can at different stations be placed across from one wire to the other of a metallic circuit without any perceptible diminution of the effect at any one of them. This is one of the most important results of the self-regulating attribute of self-induction.

Perhaps, however, the most valuable instance of turning an electrical enemy into an electrical ally, is the way in which by the proper use, construction and arrangement of electro-magnets, a plurality of either telephonic or partially telephonic and partly telegraphic messages may be transmitted over the same circuit at the same time.

The pioneer in this kind of work was C. F. Varley, who as early as 1870 took out a patent, No. 1,044 in England, for a combined simultaneous ordinary Morse and harmonic Morse transmission over the same wire; in this system the straight Morse was worked through electro-magnets, while the harmonic branches were led off from the main line from points outside of the electro-magnets.

Carrying on this line of invention, Mr. Van Rysselberghe of Belgium, and Dr. Rosebrugh of Toronto, Canada, have worked out systems whereby telegraphy and speaking telephony can be at the same time operated over the same circuit.

Since, however, there is enough in either system to fill up a paper devoted to them exclusively, and since this paper is already too long, I find it impossible here to describe them in detail, reserving this possibly for some future occasion.

Self-induction has also been caused to aid in eliminating the disturbing results of extraneous induction caused by parallel circuits, as in the United States Patent of Mr. Edison, No 203,019, of April 30, 1878, where a telephone circuit is freed from external influences by combining it with an induction coil connected with the disturbing circuits in such a manner that the direct disturbances received in virtue of the parallelism of the contiguous circuits is neutralized by an equal and opposite induction received also from them through the induction coil. This however, is not a practical expedient.

Closely analogous to the self-inductive regulation of which I have been speaking, is that upon which the efficiency of the electro-motor depends. This was first observed by Jacobi[12] who says:

"Experimenting on the magnetic force of a bar of soft iron for which I could in no way account I sometimes found considerable differences for which I could in no way account. I was curious to know if these differences proceeded from the nature of the iron, or from the weakening of the electric current produced by a voltaic pair of half a foot square of surface. For this reason I placed in the circuit, a galvanometer so distant as not to be affected by the direct magnetism of the bar. I was much astonished to see the needle recoil on placing the armature and advance on removing it, for it was the first time I had known the double quality of the connecting wire, viz., that of constructing the voltaic current, and at the same time representing an ordinary wire subject to the action of a magnet in motion. The spiral producing a magnet by the voltaic current is at the same time a magnetic electrical spiral in which a magnet is placed.

"Hence the solution of the uniform velocity of the magnetic machine. For being set in motion by the magnetizing power of a voltaic current it represents simultaneously an apparatus composed of magnets in motion, and capable of producing a magnetic electrical current in a direction opposite to that of the voltaic current."

Jacobi in a subsequent paper, practically elucidated the principles of the operation of counter e. m. f. in electro motors: even as now understood, although he possibly did not state them as we now would. But he clearly showed that a motor may be regarded as a dynamo acting to develop an electromotive force, opposite in direction to that acting upon it, E. That the resultant force was of course E-e, and that this, together with the resistance of circuit determine the strength of the current. That the motor utilizes Ce of the electrical power supplied CE; and he furthermore showed that the power developed by the motor Ce, is at its maximum when e equals one-half E.

It may be thought by some that considering the title of the paper the principal utilization to which I have referred, viz., the use in regulation of systems of alternating currents operating converters should have been discussed. It does not seem to me that it is necessary; this has often been done, and will again often be done by others much more competent than myself to handle the subject. But it does seem right that one should be found to give due credit for those who, in the same line of thought are "not lost, but gone before," and I am glad that I am in a position so to do.

There seems little need for me to cite any more instances, showing that like nearly all new arts, the art of regulation by means of self-induction and of otherwise usefully employing the counter e. m. f. due thereto, is not *quite* new, and that while we can congratulate ourselves upon the achievements of the present, we should not fail to respect the foundation layers of the past, for of a truth there were giants in those days.

The following paper on the "Magnetic Data of the Sprague Street Car Motor," by Ed. H. Parshall, of New York, was read:

Magnetic Data of the Sprague Street Car Motor.

By H. F. Parshall.

Figures giving the ratios of the lines of force through various parts of the magnetic circuit to the lines of force through the armature have occasionally been fully published, the most noticeable being those given in a paper by Hopkinson some years ago. These ratios vary in the same type of dynamo or motor with any change of proportion; or, to put it in another way, in order that these ratios may remain constant in the same type, the ratios of the magnetizing force in the one part of the magnetic circuit to the magnetizing force in the other parts, must also remain constant.

In making calculations on various motors made by the Sprague company, I have found it necessary to confirm the assumed values of these ratios by measurements. It is the object of this paper to give the results of the measurements made on the street car motor, together with sufficient description, to make the values found of some use to those engaged in similar work. If I had had any intention of publishing these results, I would have endeavored to make them, in some ways, more complete than they now are, but so little detailed information exists on this subject, I have decided to give the result of my work up to date on this particular motor. The conditions under which this work has been carried on have not at all times been the most favorable for accuracy, but in the main, the results have been satisfactory.

Fig. 1 shows the various peculiarities of the magnetic circuit, and gives dimensions of the several parts. The most noticeable points are:

The bell mouthing of the pole pieces shown in the section "A B A." This bell mouthing greatly lessens the sparking, as does also cutting away of the tips of the pole pieces, as shown in "A B." With these modifications the brushes can be shifted an angle of 20 degrees without serious sparking.

The other noticeable points are the cast-iron side brackets, the width of the yoke and its comparative thinness.

The method of getting the ratio of the lines of force in one part to the lines of force in another was the usual one. Coils of a few turns were wound around these parts, and connected to a ballistic galvanometer, and when the needle was standing at zero, a known magnetizing force was suddenly reversed

The galvanometer used was an Edelmann with a heavy ring form of needle very slightly damped. The deflections being small, it was assumed that the first throw was proportional to the induction through the measuring coil. The magnetizing coils were those commonly used on this motor.

Each coil was wound approximately to a depth of 4 centimeters, and along the cores 8.5 centimeters

Coils were as follows:

First. Nearest the pole piece 28 turns per layer, 11 layers.

Second. 31 turns per layer, 11 layers.

Third. 31 turns per layer, 13 layers.

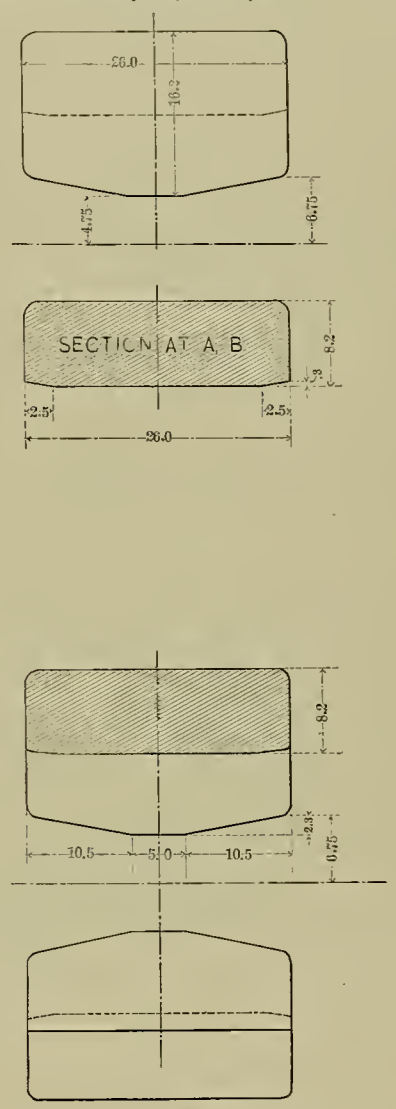


FIG 1.

This gives 2 104 turns for both cores, or with a current of 6.75 amperes, which was used throughout a magnetizing force of 14,200 ampere-turns.

By noticing the curves in Fig. 2 it will be seen that this is the part of characteristic upon which the motor is most frequently worked. With different values of magnetizing force, different values of the ratios would be found. This becomes evident when we remember that the resistance of the gap remains constant, while the resistance of the iron increases with the magnetizing force. For this reason the curves of magnetization of the *different* parts of the magnetic circuit are not given.

The measuring coils were 4 turns of wire wound around the armature core at E, F., on the pole piece; at A, B., on the magnet core, midway between the ends and on the yoke at G, H; had it been possible a coil would have been wound around both the yoke and side brackets.

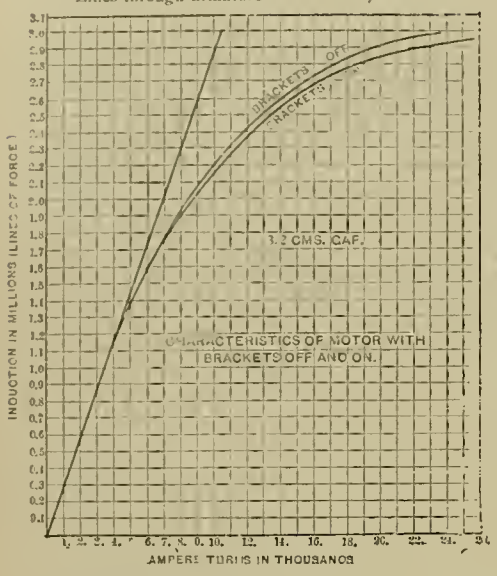
The following values were found:

Lines through magnet / Lines through armature	1.45
Lines through middle of yoke / Lines through armature	1.27
Lines through middle pole piece / Lines through armature	0.666

12. Sturgeon's Annals of Elty, 1837, Vol. 1, pp. 408-419

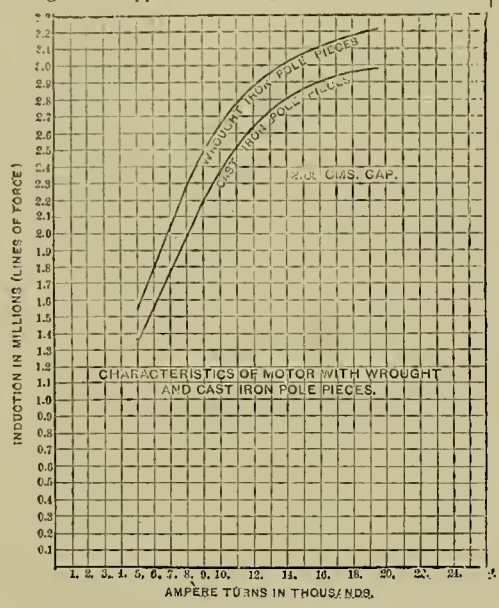
Cast iron pole pieces.

Lines through magnet / Lines through armature } 1.52



Lines through middle of yoke / Lines through armature } 1.33

The effect of the leakage from the side brackets is shown in Fig. 2, the upper curve being the characteristic with them removed, and the lower curve being the characteristic with brackets on. The dropping of the curve shows the magnet cores are sonner saturated with the brackets on.



Lines through middle pole pieces / Lines through armature } 0.

The difference is small. It would be somewhat greater did not the brackets reinforce the yoke. These curves were first obtained by separately exciting the fields, and taking the number of revolutions, with a driving current of one ampere through the armature.

The lower curve has, by comparison, been found to be a close approximation to the characteristic when the armature is run with currents for which it was designed.

Fig. 3 shows the characteristics of two motors, one with the wrought-iron pole piece, and the other with the cast-iron pole piece, the gap being 2.85 instead of 3.2, the side brackets being on in each case. The difference between these two characteristics is somewhat striking, and carries its own lesson.

I wish here to acknowledge my indebtedness to G. J. Scott for the assistance he has given me in making measurements.

The plate shows two forms of pole piece; one has a full line. This is the cast iron; the dotted line shows the wrought-iron pole piece.

At the afternoon closing session the newly-elected president, Prof. W. A. Anthony of Manchester, Conn., occupied the chair Oscar T. Crosby of New York, read the following paper on the "Limitation of Steam and Electric Transportation."

The Limitations of Steam and Electricity in Transportation.

BY O. T. CROSBY.

"Do you expect electric engines entirely to displace steam locomotives on all railroads?" That is a question which has doubtless been propounded to many electrical engineers. Its answer has doubtless been made, in general, by wise reference to the boundless possibilities of direct production of electrical energy from heat, and to Bellamy's "Looking Backward" storage batteries.

To make some study of the boundary line dividing the province of steam locomotion from that of electric locomotion—under existing conditions of producing electric energy—is the object of this paper.

In the light of present achievements I may state, without argument, the following propositions:

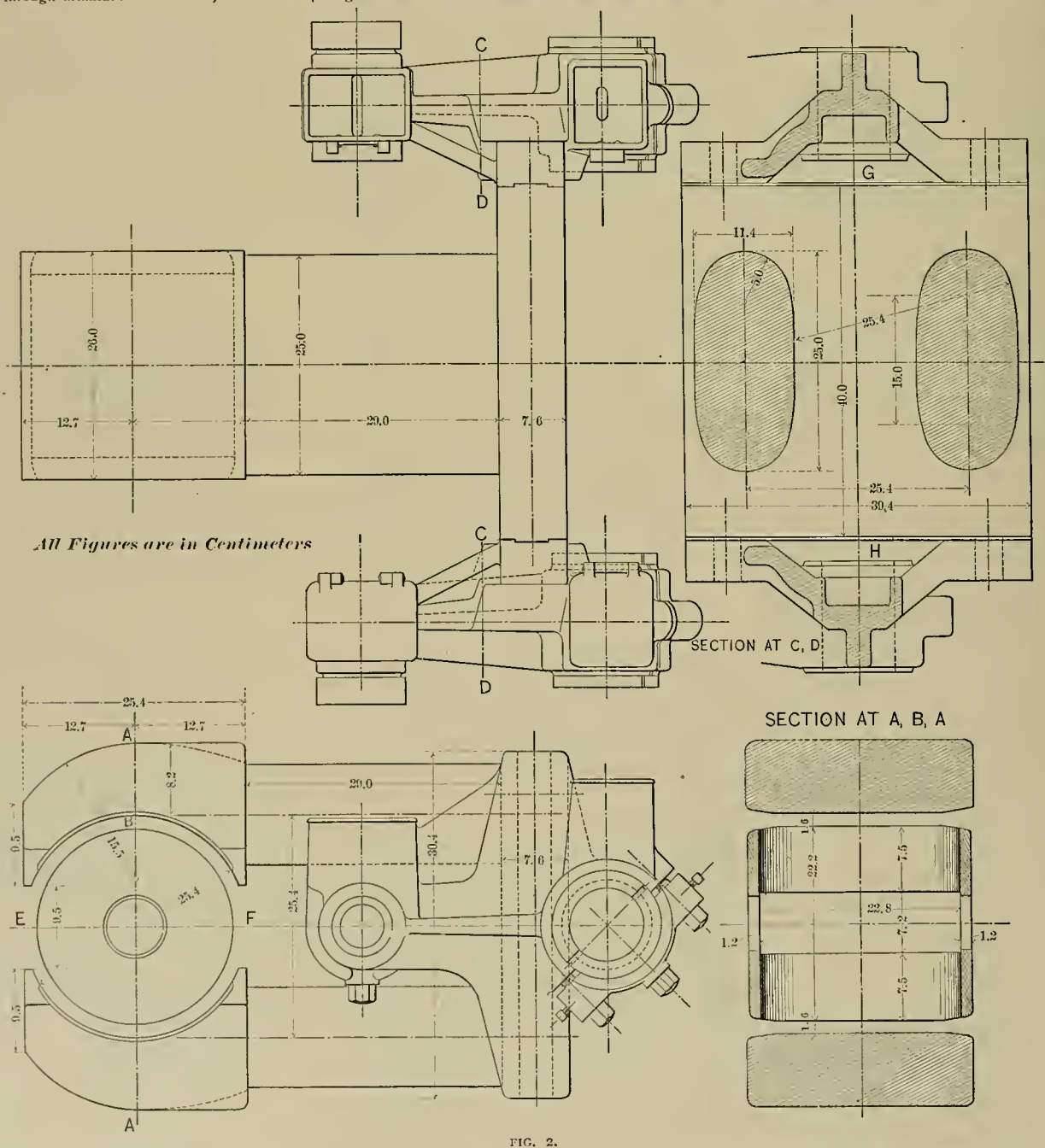


FIG. 2.

First—It is possible to construct motors capable of doing the maximum work required to-day in transportation.

Second—It is possible continuously to generate electri

energy equal to the capacity of any number of such motors.

Third—At any desired loss and over any desired distance it is possible to supply by the running contact method, the necessary current, at considerable pressure, for the working of such motors.

Should there still be question in the minds of any as to the value of the running contact method at speeds much higher than those commonly used, I may state that I have seen seventy-five amperes at 500 volts thus continuously supplied to a car moving at more than 110 miles per hour.

These premises being established, further discussion divides itself into three parts:

First, as to the mere possibility, without reference to the economy, of steam and electric propulsion under given conditions.

Second, as to to the relative cost of exerting, in a locomotive, any unit of power by electric, as compared with direct steam motors.

Third, as to the relative amount of power required by the two agents to transport a given paying load under given conditions.

In using the word steam, as above, I have in mind only the direct application of steam power on the tracks. The case of cable propulsion is not here compared, as that has, within its restricted field of application, already been compared with horse, steam and electric power.

The limiting possibilities of locomotion may be understood by considering a prolongation of the lines of present practice in the direction, first, of loads handled; second, grades climbed; third, speeds attained; fourth, length of continuous runs.

TABLE II.

ELEMENTS OF THE COST OF ONE H. P. HOUR, ELECTRIC.

Capacity. ...	100	300	500	800	1,000	1,500	2,000	3,000	4,000	5,000	6,000
Engineer.....	0.1	0.13	0.08	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Fireman.....	0.3	0.10	0.06	0.037	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Dynamo man	0.4	0.13	0.08	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Helper.....	0.25	0.08	0.05	0.031	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Superintendence...	0.30	0.10	0.06	0.037	0.03	0.02	0.015	0.001	0.001	0.001	0.001
Coal.....	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475	0.475
Oil, waste & water.....	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Interest and depreciation steam plant	0.057	0.051	0.044	0.033	0.028	0.022	0.022	0.022	0.022	0.022	0.022
Ditto electric plat.....	0.057	0.051	0.044	0.033	0.028	0.022	0.022	0.022	0.022	0.022	0.022
Ditto building	0.028	0.026	0.022	0.168	0.011	0.011	0.011	0.011	0.011	0.011	0.011

Since the effect of grade, as compared with line, is simply to increase the tractive effort required for a given load and speed, it need not be separately treated, except that there has been some question of increase of adhesion, in the ground return method, which in extreme cases might appear as an advantage for electric propulsion. The matter is not of great importance, and I will refer to it only so far as to say that interpreting my own general experience and some special tests, the adhesion co-efficient seems not increased in any practical degree by the mere passage of the current from wheel to rail.

The capacity of an electric engine, like that of a steam engine, to haul any given load, will be measured by the tractive effort possible to be produced and the relation between weight and adhesion for given track conditions. The ready multiplication of cylinders in the one case and armatures in the other, while maintaining mechanical unity as to drawbar division and the ready coupling of distinct locomotive units, renders the whole question of capacity to exert a given horizontal effort, without regard to the time element, unimportant and indefinite.[1] It goes without saying that, if desired, a single armature may be constructed capable of exerting as great a drawbar strain as any locomotive now in use.

As to limiting speed, it is not easy to-day to make "an educated guess" either for steam or electric propulsion. The high figures for steam that have been recently presented, both from England and America, are higher than the limiting figures as they would have been given by many competent authorities only a few years ago. Eighty-six ton, as per indicator card in the eighty-six mile run, was only 13.4 pounds. According to Searle's formula, adopted by Wellington, it should be sixty-nine pounds, engine and tender being taken at fifty tons. The load of 347 tons was carried at eighty-six miles per hour by an expeditore of 1,068 horse power—this on a level. The engine was compound.

Would it be possible to attain a speed twice as great, or say 150 miles per hour?

A driver twenty-four feet in circumference would require to revolve 550 times per minute in order to travel 13,200 feet per minute, or 150 miles per hour—this without slip. Since in the case considered the revolutions per minute reached 309, and since in the Reading case a much higher rate must have been reached, the drivers being smaller, and since on a stationary engine a speed much above 550 revolutions per minute has been attained, it seems beyond question that from this point of view the supposed case is quite possible.

Considering the matter of steam supply, we are again brought to consider the whole matter of train resistances at all speeds.

Total resistance to motion should be sharply divided into two classes: the resistance due to motion through air, and that due to friction and blows between vehicle and track, and to friction and blows between parts of the vehicle.

For the most part those who constructed the formulæ now found in text-books, worked on road beds far inferior to the best work of to-day, at speeds much less than those now attained, and with wrong values for at least one of the species of resistance, the atmospheric. On this point I have recently been able to present as the results of experiments at high velocities, made by Benjamin. J. Dashiell, Jr., and myself, a formula showing the pressure to be a function of the first instead of the second power of the velocity as ordinarily assumed. A convenient datum point may be given, stating that at 100 miles per hour the pressure on one square foot, normal to the direction of motion, is thirteen pounds, while proper shaping of the front may reduce this 6.5 pounds.

The absolute values given, while corresponding quite closely with those of received formulæ in the neighborhood of the velocities heretofore experimentally attained, depart widely from those assumed for velocities higher than thirty miles per hour, and calculated by the quadratic relation between velocity and pressure. Using the more trustworthy values, I have been able to separate more nearly than has heretofore been possible the atmospheric from all other resistances met at high velocities. Some inaccuracy still remains, by reason of the difficulty of obtaining exact measure of the resisting areas in a train, but I have been able, by study of careful tests made by others on the New York Central and on English roads, to find that over the range from about forty up to eighty miles per hour the tonnage coefficient seems practically constant at eight pounds. This, of course, applies only to first-class road bed and rolling stock. Whether this coefficient remains constant at higher speeds we do not know. There is no reason to assume, as has often been done, that it increases with the square of the velocity, and on the other hand it will not be safe to assume constancy. From experiments made with a single 2.5 tons car at about 100 miles per hour, the tonnage resistance at that speed seems to be about twenty pounds per ton. Though this value seems quite high as compared with the eight pounds at eighty-five miles per hour, the difference is in large part to be explained by the poor condition of the track used for the experiment, and a constant curvature which would call for about four pounds per ton. Until better evidence can be had it will be safe, at least, to assume a value of 20 pounds per ton, on a first class track, with good rolling stock, at 125-150 miles per hour.

Having made this necessary digression, we may return to the matter of steam supply, and state that by reducing weight and area, both to something less than one-half the original values in the 86 mile run, the same effort would produce the speed 150, instead of 86. The area cannot be thus reduced, but by assuming a greater reduction in weight—say to 100 tons, or to little more than engine and tender—maintenance of the higher speed becomes possible, with nearly the same steam expenditure as in the recorded case.

To attain that speed, from rest, might require such original weight of fuel and such length of favorable track as to make the feat practically impossible with steam. This leads us to inquire into the dead weight necessary for hauling say one ton at different speeeds.

From the table of horse power required for exertiog the tractive effort for one ton at various speeds, at various efficiencies, with various values of cross-section per ton, and with the two agents—steam and electricity:

Column 1. shows speed in miles per hour from 20 to 140. Column 2, corresponding tonnage coefficient, or resistance, in pounds per ton inclusive of atmospheric resistance. Columns 3 to 8 inclusive show horizontal effort needed for overcoming atmospheric resistance under various assumptions as to area exposed per ton, for 1 square foot to .1 square foot per ton. The former figure corresponds nearly to the case of a heavy locomotive propelling itself alone. As load is put on behind it, other ratios are formed. Oblique surfaces are supposed to be reduced to equivalent normal surfaces. Columns 9 to 14 inclusive show rate of work in horse power per ton, for the various cases of area exposed to atmospheric resistance, efficiency of locomotive being taken at 90 per cent. Columns 15 to 17 inclusive show h. p. per ton for the extremes and middle cases of exposed area, and for locomotive efficiency of 80 per cent. Columns 18 to 20 inclusive show same for efficiency of 60 per cent. Columns 21 to 26 inclusive show weight of coal and water per ton carried for one hour, assuming 5 lbs. coal and 15 lbs. water per h. p. hour on a steam locomotive. The coal figure is very close to actual practice.

The water figure is less, but makes allowance for scooping water at convenient intervals. Continuous scooping is not considered practical or economical. Columns 27 to 29 inclusive show weight of steam locomotive and tender required to generate the required h. p. per ton, under the assumption of 100 pounds per horse power and 90 per cent. efficiency. Only three cases of exposed area are taken; that is, one foot, one-half a foot, and one-tenth of a foot per ton. The weight of steam locomotives is not calculated for any other efficiency figure than 90 per cent.,

TABLE III.

TOTAL COST OF ONE H. P. HOUR.

Output in per cent. of capacity while working.	Hours of work per day.	Capacity of Station. 100	300	500	800	1000	1500	2000	3000
100	24	2.42	1.29	1.06	0.9148	0.869	0.835	0.825	0.816
"	18	2.52	1.36	1.115	0.938	0.883	0.855	0.849	0.829
"	12	2.85	1.52	1.223	1.028	0.955	0.95	0.895	0.867
90	24	2.62	1.36	1.12	0.947	0.88	0.86	0.85	0.83
"	18	2.77	1.45	1.17	0.98	0.91	0.88	0.87	0.853
"	12	3.10	1.61	1.29	1.06	0.99	0.94	0.925	0.89
80	24	2.87	1.45	1.18	0.987	0.92	0.91	0.88	0.86
"	18	3.00	1.55	1.23	1.03	0.98	0.936	0.926	0.90
"	12	3.42	1.73	1.37	1.13	1.06	1.030	0.98	0.95
70	24	3.19	1.57	1.26	1.04	0.96	0.925	0.91	0.89
"	18	3.42	1.64	1.32	1.09	1.01	0.952	0.94	0.91
"	12	3.82	1.90	1.48	1.19	1.09	1.02	1.01	0.97
60	24	3.62	1.73	1.36	1.11	1.01	0.975	0.96	0.94
"	18	3.85	1.85	1.44	1.16	1.06	1.015	1.00	0.965
"	12	4.31	2.11	1.63	1.30	1.17	1.085	1.07	1.015
50	24	4.22	1.95	1.52	1.20	1.10	1.045	1.03	1.00
"	18	4.50	2.10	1.61	1.27	1.15	1.09	1.076	1.039
"	12	5.00	2.40	1.83	1.43	1.28	1.19	1.17	1.114
40	24	5.11	2.28	1.73	1.35	1.21	1.15	1.13	1.10
"	18	5.47	2.48	1.88	1.44	1.33	1.25	1.23	1.17
"	12	6.20	2.82	2.17	1.64	1.50	1.38	1.35	1.28
30	24	6.53	2.84	2.10	1.59	1.40	1.325	1.30	1.26
"	23	7.08	3.02	2.27	1.71	1.50	1.40	1.38	1.32
"	12	8.06	3.53	2.65	1.98	1.73	1.57	1.54	1.44

as this seems to be quite constantly attained or surpassed. The assumption of 100 pounds per horse power is closely true for many good types of locomotive when working at speeds from 60 to 80 miles. At lower speeds this figure is too low, but it is assumed that for any ruling speed engines may be built of minimum weight for that speed. In passing through lower than ruling speeds, both electric and steam motors work at low output per pound of weight, hence the assumption of constant weight per horse power will not introduce error materially affecting comparative results. At higher speeds than 80 miles existing engines would show less than 100 pounds per horse power; but as their boiler capacity is reached at that speed, the necessary increase for any regular work would carry the weight figure to very nearly the figure given for the 60 to 80-mile running. Columns 30 to 32 show weight of steam locomotive and tender, plus weight of fuel and water, per ton hauled, also weight of load-freight and freight car that may be hauled by such weight of motive power, the load figures being obtained by subtracting the motive power weights from 2,000 pounds. Columns 33 to 41 show corresponding figures for electric locomotives under the assumption of 60 pounds per horse power, and at the three efficiencies, 90, 80 and 60 per cent.

TABLE I.

Speed	Tonnage.	Areas exposed per ton in sq. ft. 1.0	0.75	0.5	0.25	0.2	0.1	Rate of work in H. P., 10 per cent. loss. 2 and 3	2 and 4	2 and 5	2 and 6	2 and 7	2 and 8	H. P. at 20 per cent. loss. 2 and 3	2 and 5	2 and 8	H. P. at 40 per cent. loss. 2 and 3	2 and 5	2 and 8
		Horizontal effort.																	
20	8	2.6	1.95	1.3	0.65	0.52	0.26	0.61	0.58	0.534	0.501	0.49	0.48	0.70	0.07	0.55	0.93	0.8	0.73
40	8	5.2	3.90	2.6	1.3	1.04	0.52	1.56	1.40	1.23	1.068	1.05	0.99	1.77	1.40	1.12	039	1.86	1.5
60	8	7.8	5.85	3.9	1.95	1.56	0.78	2.77	2.43	2.09	1.75	1.67	1.54	3.15	2.37	1.77	4.20	3.2	2.37
80	8	10.4	7.80	5.2	2.6	2.3	1.04	4.32	3.70	3.00	2.46	2.35	2.09	4.90	3.50	2.37	6.53	4.6	3.2
100	12	13.0	9.75	6.5	3.25	2.6	1.3	7.32	6.35	5.40	4.45	4.27	3.90	8.32	6.15	4.42	11.1	8.16	5.9
120	15	15.6	11.70	7.8	3.9	3.12	1.6	10.79	9.39	8.03	6.65	6.37	5.84	12.21	9.12	6.66	16.3	12.2	8.85
140	20	18.2	13.65	9.1	4.55	3.64	1.82	15.67	13.7	11.83	10.66	9.75	6.95	17.80	13.5	10.17	23.6	18.0	13.5

miles per hour in England on the Northeastern railway, eighty-seven miles per hour in this country on the Reading railway, have both been reported since January 1, 1890. These runs are noteworthy, not only for the fact of unusual speed, but because, as shown by indicator cards in the English case, and as may be deduced from the consideration of the maximum cylinder power in the American case, the train resistances are far below the values that would have been predicted by even the most liberal of the received formulæ on the subject. The total resistance per

The 60 pounds per horse power cover weight of containing car for motors. I cannot here go into detailed figures on this point, but believe that any investigation will find the figure safe, supposing always that the unit be, say, 25-horse power or more. I also know of experimental work now progressing under most competent direction, which gives fair promise of leaving this figure much too high. Columns 42 to 53 inclusive show the horse power required to be exerted for hauling one ton of load, i. e., freight and freight car, the relation between these two being taken as the same for either steam or electric propulsion, hence not necessary to enter here. These columns apply to steam at 90 per cent., and to electricity at 90, 80 and 60 per cent., and for the three cases of exposed area. They are readily obtained from the previous columns by making allowance for the horse power necessary to haul that part of every ton, total weight, which must go into motive power, machinery and fuel. Columns 54 to 62 inclusive show the ratios between horse power required by the two agents for hauling a ton of load

[1] As an interesting example of an unusual load in steam service, I may refer to one consisting of 156 loaded cars and two cabooses hauled over the Mississippi Valley railway, December, 1885. The load consisted of—

	Pounds.
Cotton weighing	3,226,000
Cars weighing	3,239,000
Engine and tender weighing	147,000
	6,612,000

Speed was about ten miles an hour.

(freight and freight car) at the different speeds, efficiencies and area relations.

It is plain that if we can now obtain the ratio of cost per horse power hour, as given by the two agents in the correspondoing cases, we can easily determine the speeds at which the one or the other agent becomes the most economical.

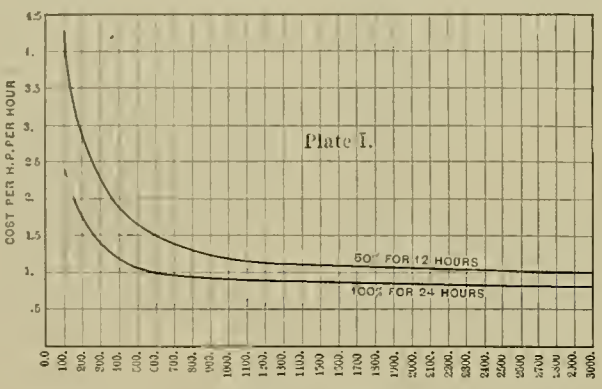
Let us first obtain the cost in electric propulsion.

For this, form Table II., showing the elements in the cost of one horse-power hour in stations of various capacity

With Table II as a basis, Table III has been calculated, giving total cost per horse power hour in stations of various capacity, working at various percentages of full capacity and for 24, 18 and 12 hours per day, respectively.

A glance at the table shows that in a 100 h. p. plant the cost varies from 2.42 cents for a 24-hour run at full capacity, to 8.06 cents for a 30 per cent. output continued only 12 hours per day.

This extreme case would doubtless be ameliorated by dropping the superintendence and combining engineer and

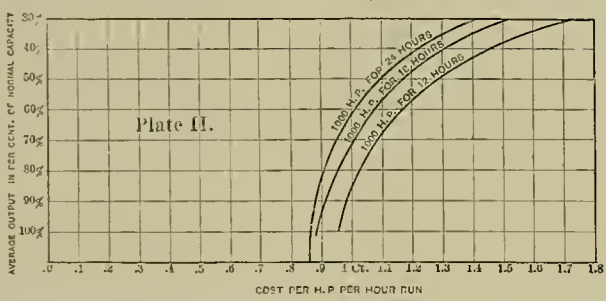


—from 100 to 3,000 h. p. Engineers and dynamo-men are assumed to receive 40 cents per hour, and to superintend a maximum of 1,000 h. p. This would produce in some cases, fractional engineers, as for a 1,500 h. p. plant, but such complication has been avoided by assuming a constant value per unit of power in the pay-roll element in plants exceeding 1,000 h. p. Firemen and helpers are taken at 30 and 25 cents per hour, respectively. Superintendence, at 30 cents per hour, is apparently low, but is equivalent to 60 cents for daylight hours, since the plant is able to

fireman—though to this the unions might object. This capacity is smaller than need be considered for any steam-line service.

The minimum cost given by the table is .816 cents, this for a 3,000 h. p. plant, working full capacity 24 hours per day.

The next element of cost—that of the conductors for the current—is obtained from Table IV, showing investment in dollars for the copper required to transmit one h. p. a distance of one mile, at varying initial and final pressures.



run 24 hours with the same general superintendence as for 12 hours. It is further supposed that the total of this item will not require increase until the capacity reaches 3,000 h. p., beyond which it remains constant per unit of power. As no other element of cost is supposed to vary beyond this point, the table shows here a minimum total cost per unit, and a constant cost beyond it.

Coal is assumed to cost $3 per ton, and to be consumed at the rate of 32 pounds per electric h. p. in the dynamo. A very slight error is made in taking the rate of consump-

The constants for this table were thus obtained: Taking a well known live wire, I find that from No. 4 to No. 000 B. W. G., the average weight-ratio of insulated to bare wire, per unit of length, equals .884. When bare copper sells at 15 cents, this insulated wire sells at 20 cents=22.5 cents on the copper alone, when insulated. If, therefore, we take copper at 25 cents per pound we provide for a very good insulation. The cost of one mil mile is thus found to be $ .004. Combining this with the familiar formula

TABLE IV.—FOR DOUBLE METALLIC CIRCUITS.
COPPER INVESTMENT FOR TRANSMITTING ONE H. P. ONE MILE.
Motor efficiency = 90 per cent.
Initial E. M. F.

Drop on line, volts.	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	7,000	8,000	9,000	10,000
100	19.00	8.44	5.42	4.00	3.20	2.60	2.20	1.80	1.60	1.44	1.40	1.28	1.10	0.98	0.84	0.76
200	13.63	4.80	3.12	2.12	1.61	1.31	1.11	1.00	0.88	0.78	0.70	0.64	0.56	0.48	0.42	0.38
300	19.00	3.60	2.12	1.50	1.20	0.94	0.80	0.68	0.60	0.54	0.48	0.44	0.36	0.32	0.28	0.26
400		3.20	1.72	1.20	0.92	0.72	0.62	0.52	0.44	0.40	0.34	0.32	0.28	0.24	0.22	0.20
500		3.00	1.50	1.00	0.78	0.60	0.50	0.40	0.36	0.31	0.30	0.28	0.22	0.20	0.18	0.16
600		3.5	1.40	0.92	0.66	0.54	0.42	0.34	0.32	0.28	0.26	0.22	0.20	0.16	0.15	0.14
700		3.60	1.34	0.82	0.60	0.40	0.38	0.32	0.28	0.24	0.22	0.20	0.16	0.14	0.12	0.16
800		4.80	1.34	0.80	0.58	0.42	0.34	0.30	0.26	0.22	0.20	0.18	0.14	0.12	0.10	0.10
900		8.44	1.40	0.70	0.54	0.40	0.32	0.28	0.22	0.20	0.18	0.16	0.14	0.12	0.10	0.08
1,000			1.50	0.76	0.50	0.36	0.30	0.24	0.20	0.18	0.16	0.15	0 12	0.10	0.08	0.08
1,200			2.12	0.80	0.48	0.34	0.28	0.22	0.18	0.16	0.14	0.12	0.10	0.08	0.08	0.07
1,400			5.42	0.90	0.48	0.33	0.26	0.20	0.18	0.14	0.12	0.10	0.08	0.08	0.06	0.06
1,600				1.12	0.52	0.34	0.24	0.20	0.16	0.11	0.12	0.10	0.08	0.06	0.00	0.056
1,800				2.12	0.60	0.34	0.21	0.18	0 16	0.12	0.10	0.00	0.08	0.06	0.00	0.05
2,000					0.76	0.36	0.24	0.18	0.18	0.15	0.12	0.10	0.08	0.06	0.051	0.048
2,400					3.20	0.52	0.23	0.20	0.14	0.12	0.10	0.08	0.06	0.05	0.048	0.01
2,800						1 34	0.38	0,22	0.10	0.42	0.09	0.08	0.06	0.05	0.01	0.038
3,200							0.78	0.30	0.18	0.12	0.10	0.08	0.06	0.05	0.04	0.031
3,600								0.54	0.72	0.14	0.10	0.08	0.06	0.05	0.04	0.032
4,000									0.36	0.18	0.12	0.08	0.06	0.04	0.038	0.032
4,500										9.60	0.16	0.10	0.06	0.01	0.035	0.030
5,000											0.30	0.15	0.06	0.01	0.035	0.030
6,000													0.12	0.06	0.01	0.032
7,000														0.10	0.051	0.030
8,000															0.08	0.016
9,000																0.008

In using the table it will be convenient to draw curves of equal cost. They will be, roughly, arcs of circles convex toward the left.

tion as constant while changing the capacity of the engines.

Cost of steam plant is taken to vary from $50 per h. p., in a small plant, to $20 in a plant of 1,500 h. p. This latter figure may seem too low to some, but I have recently seen the figures for an 800 h. p. plant, in a neighboring Massachusetts city, which cost, in place, at the rate of $22 per h. p.

Dynamo plant is taken to vary from $50 to $20 per h. p. in going from 100 to 1,500 h. p. I know that machinery of good design can be manufactured for these prices.

The cost of buildings is taken to vary from $25 to $10 per h. p. This is the most indefinite item. Interest, maintenance and taxes, are roundly assumed at 10 per cent. per annum on the whole plant.

$$CM=\frac{16{,}6co\times\text{h. p. transmitted}\times\text{distance in feet.}}{\text{E. M. F. at motor}\times\text{volts lost on line}\times\text{motor efficiency,}}$$

the tabulated values have been determined from the resulting formula,

$$\text{Cost}=\frac{760{,}320}{(E-1')\,1'} \qquad (1)$$

in which E=E. M. F. at station, v=volts lost on line, motor efficiency is taken at 90 per cent. and distance at 5,280 feet. The tabular figures give the investment. To reduce to actual cost per horse power hour, rate of interest and depreciation, and ratio between power transmitted, and power possible to be transmitted. For one year the possible horse power hours=365×24. Take annual interest and depreciation at $\frac{1}{10}$ the investment and ratio of actual to possible power transmitted per annum at 1.0, 0.8, 0.6, 0.4, 0.2, 0.1, 0.05, then the divisor of the tabular number becomes 140,160, 112,128, 84,056, 56,064, 28,032, 14.026 and 7,008 respectively.

It remains to obtain values for the distance of transmission.

Let n=number of miles of line supplied from one station.

h=horse power required for unit locomotive.

K=maximum number locomotives per mile at any time.

$n\,h\,K$=total power to be transmitted at time of K.

A=percentage of dynamo power lost on line.

$\frac{n\,h\,K}{160-A}$=maximum power to be generated.

$\frac{n\,h\,K\,A}{100-A\ 100}$=" " lost on line.

b=cost of generating one horse power hour in station.

r=ratio of average power required to maximum power required.

L=interest and depreciation on supporting structure.

This last may be omitted from the calculation, determining division of line into sections, since it remains the same, whatever that division may be. Omitting this, the expression for cost of transmission becomes:

$$\text{Cost}=\frac{760{,}320\,n^3\,h\,K\,r}{(E-1')\,v\times 140{,}160}+\frac{b\,n\,h\,k\,A}{r\,(100-A)100}$$

$$=\frac{5.42\,n^2\,h\,k\,r}{(E-v)\,1'}+\frac{b\,n\,h\,k\,A}{r\,(100-A)100} \qquad (2)$$

Supposing that the time schedule of trains, H. P. required per train, and efficiency of motors be known, and that the initial e. m. f. be in all cases taken as high as the state of the art permits the only variables remaining in this expression are n, b and A. This latter, the value for the drop on the line, will generally be determined by conditions

TABLE V.
Ratios of cost of motive power.

Efficiency of electric engine.	10 per cent.			20 per cent.			40 per cent.		
Tonnage and arrear relation.	2 & 3	2 & 5	2 & 8	2 & 3	2 & 5	2 & 8	2 & 3	2 & 5	2 & 8
Speed.									
20	1.15	1.16	1.16	0.92	0.85	0.85	0.56	0.56	0.55
40	1.19	1.19	1.17	0.95	0.95	0.95	0.57	0.57	0.56
60	1.25	1.24	1.19	1.00	1.00	0.95	0.58	0.58	0.56
80	1.33	1.32	1.22	1 07	1.03	0.91	0.59	0.59	0.57
100	1.38	1.42	1.32	1.23	1.20	1.05	0.66	0.65	0.59
120	2.57	1.94	1.17	1.66	1.49	1.13	0.80	0.78	0.64
140	10.03	3.82	1.87	7.35	2.83	1.46	2.72	1.36	0.72

other than those of the strictest economy, as shown by getting a minimum value for cost of transmission. We must have a reasonably uniform e. m. f. all along the line, in order that the motors may work satisfactorily. It will not be wide of the mark to assume 10 per cent. as a limiting variation of line potential. This is the figure generally assumed in calculating wire for street railways.

The cost of one h. p. hour b must vary with the capacity and conditions of working of the station; hence it is a function of n—*i. e.* length of unit section of A, and of that inexpressible variable—the conditions of the service. This stands in the way of obtaining any perfectly general definite expression for n, which, but for this, would result from placing the first differential coefficient of C, with respect of n, equals to zero, and solving to find the value of n giving a minimum value for C. If trains be run at very short intervals, increase of n would be followed by proportional increase in capacity of station; but as above shown, this need not go beyond 3,000 h. p. unless the service be so heavy as to require practically contiguous stations of that capacity. If we suppose a case of this short-interval service, so short that a change in n will not be followed by any change at the station in the relation between maximum capacity and average output, or in the number of working hours, but only in the normal capacity, the relation between b and n for two cases of average output and working hours is shown by Fig. 1. The equation of the 50 per cent. curve from 200 to 1,000 h. p. seems to be very nearly

$$b=n\frac{2-98n+1{,}000}{12(n-100)}$$

If the trains be run at very long intervals, we may require no greater station capacity for 20 than for 10-mile sections; but the relation of output to normal capacity will vary and possibly the number of hours during which the working force would require to be kept on pay.

ing force would require to be kept on pay.

Taking the case of a change on average output only, for a 1,000 h. p. station, we have the curves in Fig. 2, for 24, 18 and 12 hours' work. Their equations are nearly of the same form, and are approximately the equations of arcs of circles referred to an origin outside the circle. But each would contain different constants, and would vary more or less from the exact formula for the circle.

If, in the application to a particular case, the algebraic expression for b, above given, or any other resulting from any of the possible progressions through Table III, be substituted in Fig. 2, we may, by differentiation, solve that particular case for the most economical value of n. If the relation between b and n cannot be algebraically expressed, then the proper value for n may be determined

by a few trial values, the corresponding values of b being taken from the table.

For the present purposes of comparison, we will assume a case not more favorable than might often be met on busy steam lines, *i. e.*, a station of 2,000-h. p. normal capacity, working 18 hours per day at 40 per cent. of its normal output, the cost per horse power being 1.25 cents.

To obtain the cost of the line, we will assume that the average distance of transmission is five miles. This would correspond to one station for every twenty miles of road. We will also assume 5,000 volts initial e. m. f. and 10 chinery, 30 per cent.; lagging and painting, 12 per cent.; smoke-box, etc., 5 per cent.; tender (running gear, 10 per cent.; body and tank, 3 per cent.), 13 per cent.; total, 100 per cent.

Of these items we may at once, and with certainty, strike out boiler, smoke box, etc, and tender, thus dropping 38 per cent. of the total. Having no boiler to carry, the running gear will be less in quantity.

The wear will be less, due to the use of rotary instead of reciprocating effort. It will then be fair to reduce this item by half, making another saving of 10 per cent. So station for every h. p. hour actually delivered to drivers line loss being supposed constant at 10 per cent. We should then have in the station 1.56, 1.75 and 2.30 cents, respectively. Then, for total:

Station	1.56	1.75	2.30
Conductor system	0.042	0.04	0.04
Structure for same	0.09	0.09	0.09
Wages	0.14	0.14	0.14
Repairs	0.22	0.22	0.22
Interest	0.11	0.11	0.11
Total	2.16	2.35	2.80

TABLE VI.

FIGURES ON STREET-CAR TRACTION. TRACK NEARLY LEVEL.

Date.	Designation of motor-car.	Weight of motor-car and passengers.	Weight of towed car and passengers.	Length of trip in miles.	Average speed, miles per hour.	Potential at station, volts.	Ditto at car, average.	Current in motor "A," amperes.	Current in motor "B."	Current in trolley wire of car.	Difference of "A" and "B."	Number of readings averaged.	Corresponding time interval, seconds.	Total average energy in car, in H. P.	Horizontal effort read per ton, in pounds.	Corresponding mechanical H. P.	Hysteresis, eddy current and friction in armature "A," watts.	Ditto in armature "B."	C²R loss in "A," watts.	Ditto in "B."	Total loss in motor or motors, H. P.	Total gearing loss, H. P.	Efficiency of motor or motors.	Ditto of gearing, one or two sets.	Ditto of motors and gearing.	Record number of run.	Remarks.
April 3	No. 6	Pounds. 12,000	0	3.5 and return, 7.0	9 3	480	440	6.63	6.63	13.27	262	10	7.63	27.5	4.69	550	550	88	88	1.71	1.83	77.4	69.0	53.6	1	Track this day rather dirty. Tonnage co-efficient taken for higher than Apr. 20, when observations were made.
3	6	12,000	0	2.81 and return, 5.78	10.45	480	440	7 6	7.6	15.2	185	10	6.92	27.5	4.6	600	609	115	115	1.97	2.4	75.0	65.7	51.5	2	
3	8	12,000	0	2.81 and return, 5.78	11.5	480	440	11.85	0	11.85	135	12	6 95	27.5	5.06	675	0	230	0	1.2	0.7	82.7	87.8	72.7	3	Armature of motor "B" taken out for this and trip No.
3	8	12,000	0	3.5 and return, 7.0	9.1	480	440	10.0	0	10.0	230	12	5.87	27.5	4.0	550	0	200	0	1.0	0.87	83.1	82.1	68.0	4	
20	8	11,850	6050	2.84 and return, 5.78	10.0	480	440	7.85	7.85	15.7	144	15	9.25	25	6.0	600	600	123	123	1.94	1.31	79.0	82.0	64.8	6	Dynamometer between motor and tow car. 131 readings taken.
20	8	12,000	7200	2.81	8 3	480	440	12.26	0	12.26	85	15	7.23	25	5 31	500	0	300	0	1.07	0.85	85.2	86.0	73.0	6	Motor "B" out out of circuit.
May 2	8	12,400		2.84 and 3.5 6.34	10.9	480	440	7.68	5 52	14.2	1.16	131	15	8.37	25	4.5	550	650	118	61	1.98	1.89	78.3	70.4	53.7	7	Separate ammeter in each motor circuit and in main.

A and B assumed equal except when difference was measured.

NOTE.—Voltmeter readings taken April 3 and 20 assumed same values May 2. Traction co-efficient also taken from April 20, as track was in same condition. Losses in motors cannot be given with perfect accuracy, as they have not been determined for wide ranges of condition by shop tests. Values for hysteresis, etc., here taken correspond closely with several shop tests. Except C²R, motor loss does not vary largely with current flowing in practice, as with a low current, a very large armature induction is effected. The "R" in C²R cannot be known accurately, as it constantly changes with change in position of switch. A fair average of switch position was obtained from observation. Total error in motor losses probably not greater than 10%. Run No. 7 not introduced here for discussion of difference of action of motors "A" and "B."

Average efficiency whole mechanism, two motors=55.9 per cent.
" " " " one motor =71.9 "
" " " one motor alone =83.6 "
" " " two motors " =77.6 "
" " " two sets gears alone=71.8 "
" " " one set gears=85.3 "

per cent. drop. From Table IV the copper investment is found to be 34 cents for one mile. Then for five miles investment equals $8.50. Making assumptions as to service corresponding to those for the station, we have cost of one horse power hour equaling $8.50 ÷ 20,000 = .042 cents.

The structure for carrying the conductors may be built for $2,000 per mile. Interest and depreciation would then become $200 per annum. This total is almost wholly in-

in the machinery item, there can be no question that with the rapid advance toward slow-speed motors, reducing gearing, and sounder insulation methods, the great advantage of having only *one moving part* in the motor itself must operate to very largely reduce the repair figure, probably to half its value in a steam locomotive, leaving it at 15 per cent. In lagging and painting the omission of boiler and other parts must again effect a reduction, say to 6 per cent. The total reduction thus plainly indicated

Of the whole amount, it is to be noted that the station item is three fourths. Taking the most favorable case shown by the table—3,000 h. p. capacity, working for twenty-four hours at 100 per cent. of capacity—these figures become 1.5, 1.62 and 2. cents nearly, the reduction in the other items being still a little indefinite, without making another series of independent assumptions.

The cost of one h. p. hour with steam locomotives, is to be obtained only by some circumlocution, the reports,

TABLE VII.

Speed.	Tonnage	Coal and water for one hour. 5 lbs coal. 15 " water.						Locomotive and tender at 100 lbs: per H. P.			Weight machinery, fuel and load, steam.			Wt. machinery and load, electric.			Wt. machinery and load-elec., 20 per cent.			Machinery and load, elec., 40 per cent.		
		2 & 3	2 and 4	2 and 5	2 and 6	2 & 7	2 & 8		2 and 5	2 and 8	2 and 3	2 and 5	2 and 8	2 and 3	2 and 5	2 and 8	2 and 3	2 and 5	2 and 8	2 and 3	2 and 5	2 and 8
20	8	12.3	11.06	10.65	10.12	9.9	9.6	61.6	58.3	48.4	73	69	57	1964	1963	1971	1958	1964	1967	1914	1952	1956
40	8	30.8	27.9	24.6	21.30	21.07	19.8	154	139.7	99.0	1927	1931	1943	36.6	32.	28.3	42.	36.	33.	55.8	48	438
60	8	55.4	48.6	41.8	35.0	33.4	30.8	277	243	154	185	164	119	1906	1926	1941	1894	1916	1923	1858	1888	1910
80	8	8.26	73.9	61.8	49.3	47.1	42.1	431	370	210	1815	1826	1881	93.6	73.8	59.4	106.2	84.	67.2	142.2	111.6	90
100	12	14.65	131.2	108.2	89.0	84.3	77.8	733	636	389	332	285	185	1834	1875	1908	1811	1858	1892	1738	1808	1858
120	15	215.4	187.88	160.	133.0	127.4	116.8	1078	939	584	1668	1715	1815	166 2	125.4	92.4	189.0	142 2	1062	262	192.	142.2
140	20	313.5	276.0	237.	201.0	195.1	179.1	1567	1380	895	517	432	252	1741	1829	1830	1706	1739	1808	1608	1729	1808
											1483	1568	1748	259.2	18.0	120.	294	210.0	142.2	331.6	279	192
											878	744	477	1561	1676	1766	1560	1631	1735	1334	1570	1646
											1122	1256	1623	433.2	324	254	499.2	389	265.2	666.	489.6	354
											1293	1099	701	1354	1518	1650	1263	1453	1600	1022	1268	1469
											707	901	1299	646.2	481.8	350.4	142.6	547.2	399.6	978	732	531
											1889	1617	1074	1000	1287	1517	932	1190	390	584	920	1100
											120	383	926	940.2	712.8	483.	1068	810	610.2	1416	1080	810

dependent of the power transmitted, hence the cost per unit of power will vary directly with the number of units transmitted. Assuming a constant distribution of one 500 horse power train for every 20 miles of line, we have cost of this item for one h. p. hour:

$$20{,}000 \div 365 \times 24 \times 25 = .09 \text{ cents.}$$

Reaching the locomotive, we must add, supposing an average output of 500 h. p., .08 and .06 cents respectively for driver and his assistant. The latter is necessary only as a substitute for his principal in case of emergency,

must be then very nearly 70 per cent.

The actual cost of repairs to-day on steam locomotives is, on the P. R. R., nearly .75 cents per h. p. hour, as will later appear. Reducing as above, this figure becomes 22 cents for electric traction. This refers to engines of considerable power, say from 400 to 1,000 h p. capacity. The figure for both steam and electric motors would go up for smaller powers.

The interest charge results from considering the cost of an electric locomotive as $50 per h. p. and the duty as six

of cost being based on train-mile. As quoted by Wellington, the coal consumed per passenger train mile on the Pacific Railroad, is very close to 50 pounds, and an average performance will show 5 pounds coal per horse-power hour, while *under way*. This shows that one train-mile equals 10 horse-power hours. The coal consumption for a freight train mile is much higher, but the divisor would also be higher, on account of the greater number of stops, or at least of backing and switching, and greater delays while on a trip, thus increasing waste of coal.

TABLE VIII.

Speed.	Tonnage	Power for one ton freight and car, steam, 10 per cent.			Power for one ton freight and car electric. 10 per cent.			Power for one ton electric at 20 per cent.			Power for one electric. 40 per cent. loss.			Ratio equals Steam / Electric 10 per cent.			Steam 10 per cent / Elec. 20 per cent.			Steam 10 per cent. / Elec. 40 per cent.		
		2 and 3	2 and 5	2 and 8	2 and 3	2 and 5	2 and 8	2 and 3	2 and 5	2 and 8	2 and 3	2 and 6	2 and 8	2 and 3	2 and 5	2 and 8	2 and 3	2 and 5	2 and 8	2 and 3	2 and 5	2 and 8
20	8	0.633	0.55	0.49	0 62	0.54	0.48	0.715	0.68	0.56	0.95	0.82	0.75	1.01	1.02	1.02	0.88	0.81	0.87	0.66	0.67	0.65
40	8	1.72	1.34	1.25	1.63	1.27	1 02	1.83	1.46	1.15	2.55	2.0	1.67	1.05	1.05	1.03	0.91	0.92	0.91	0.67	0.67	0.63
60	8	3.82	2.44	1.70	3.02	2.23	1.61	3 48	2.55	1.87	4.8	3.54	2.55	1.1	1.09	1.0	0.95	0.95	0.91	0.69	0.68	0 66
80	8	5.83	3.82	2.28	4.96	3.3	2.13	5.71	3.91	2.55	8 12	5.34	3.54	1.17	1.16	1.07	1.02	0.98	0.99	0.71	0.71	0.65
100	12	13.05	8 60	5.12	9.38	6.44	4.42	11.03	7.54	6 09	16.6	10.8	7.17	1.39	1.33	1.13	1.17	1.14	1.00	0.78	0.8	0.71
120	15	30.4	17.8	9.0	15.9	10.5	7.08	19.25	12.5	8.35	31.8	19.25	12.0	1.91	1.7	1.27	1.58	1.42	1.08	0.95	0.92	0.75
140	20	260.3	62 0	19.3	295.6	18.46	11.8	38.2	22.7	14.63	80.8	39.1	22.7	8.8	3.35	1.64	7.00	2.7	1.39	3.2	1.6	0.85

but as such he would doubtless always be placed on trains of considerable value.

Repair on electric locomotives is not as yet well defined. That the repair bill must be far less than in the case of steam locomotives follows almost necessarily from the great reduction in the number of parts, especially of moving parts.

From Arthur Wellington's very valuable work on railways, I take the figures showing percentage distribution of locomotive repairs, by parts.

Boiler, 20 per cent.; running gear, 20 per cent.; ma-

hours per day full capacity. The average duty of steam locomotives is only about three hours. The higher figure results from a smaller number of repairs necessary, due to greater simplicity of parts. Then.

$$\text{Interest for h. p. hour} = \frac{\$50.00 \times .05}{365 \times 6} = .11 \text{ cents.}$$

Before summarizing we must know something of the efficiency of the system. If the locomotive be of 90 per cent., or 80 per cent., or 60 per cent. efficiency, we must generate, respectively, 1.25, 1.4 and 1.85 h. p. hours in the

Again, the Pacific Railroad reports show cost of fuel per train (mail) 5 cents. The cost of coal to that company, as nearly as I can learn, is about $1.50 per ton. Hence it would appear that 66 pounds per train mile are consumed. As the terminal losses of fuel and delay (getting up steam and drawing fires, etc.) are known to be in the neighborhood of 25 per cent. of the total consumption, we have 6.6 pounds as the divisor, and the same ratio again appears.

The cost of one train mile—as to motor power alone—is given by the Pacific Railroad as 22 cents. And this is practically equal to the average for the North Shore. The

itemized statement is very carefully made up, and seems to cover everything except interest on the engine investment.

Knowing the annual mileage per locomotive to be about 20,000 and the cost to be $10,000, interest charge per train-mile (not quite, but nearly equivalent, to engine mile) becomes 2.7 cents. Total cost becomes 24.7 cents, or 2.47 cents per horse power hour, efficiency being constant at 100 per cent.

We may safely use this figure in the comparison to be made, since any positive error in the calculation of coal per horse-power hour, or negative error in horse-power hours per train-mile, will be offset by the difference in cost of coal per ton to the Pacific Railroad as compared with the value assumed in Table III.

At $3, instead of $1.50, the full item would be 10 cents and the total motive power 29.5 cents. Leaving the statistics of actual cost, we may reach, by the method of Table III., nearly the same figure, considering the locomotive as a 1,000 horse power steam plant, of low first cost, burning 6 pounds coal per horse-power hour, and working at one-third capacity for about three hours per day. The result thus reached is about 10 per cent. higher, but the 2.47 cents seem most reliable.

These values multiplied into the corresponding values in the last nine columns of Table 1, give the following values of:

$$\frac{\text{Power units, steam} \quad \text{cost per unit, steam.}}{\text{Power units, electric} \quad \text{cost per unit, electric.}}$$

This value being greater than unity indicates greater economy by electricity than by steam, and vice versa.

A glance at the table shows the dominating necessity of increasing the efficiency of the mechanism delivering energy from the electric line to the vehicle. We cannot count upon a higher efficiency than 90 per cent. for the motor. Hence, save in the case of putting the armature directly on the axle, we cannot hope to reduce the total loss to less than 20 per cent.—a case permitting one set (*i. e.* two gross) of spun gearing between armature and axle. As the ordinary relations between tonnage and resisting area will lie between the second and third columns of each efficiency table, it appears that with a 20 per cent. loss electricity becomes cheaper than steam at about 70 miles per hour.

In the case of forty per cent. loss our new agent betters the old only at 140 miles per hour. And yet this loss—40 per cent.—is about the best we do with our present systems of electric propulsion. This appears from the following tabulation of results obtained by me on the Brooklyn & Jamaica Electric railway

Considering the very short life of the art, these results are excellent. Indeed, excellence is shown in the mere fact of success in competing with horses under conditions very trying for any mechanism not made of India-rubber or whit-leather. How great that success has been I need not here proclaim. But the steam locomotive is a foeman more worthy of our steel, or rather of our annealed soft iron and 99 per cent. copper.

Consideration of all that precedes leads to the following general conclusions:

1. A slow-speed armature placed on the car axle would place the electric motor in the lead at all service speeds

2 For speeds above 70 miles per hour an electric motor of 90 per cent. efficiency, working through gearing of 90 per cent. efficiency, would prove more economical than the steam locomotive—save in cases of very infrequent service on very long lines.

3. On lines for heavy traffic steam would be more economical than electricity if motor and gearing have a combined efficiency as low as 60 per cent., up to 100 miles per hour.

4. At speeds of 100 miles per hour and upward, neither steam at 90 per cent. nor electric apparatus at 60 per cent. efficiency is commercially practicable.

5. Inasmuch as the saving of coal in stationary, as compared with locomotive engines, is one of the chief causes of the greater economy of electric propulsion at any speed, this advantage will increase with that difference and also with the price of coal.

6. Any cause other than inefficiency of motor which increase the power required to haul a ton of freight, increases the advantage of electricity, since it enlarges the value of the coal difference and the dead weight difference.

Thus bad roadways and large areas exposed to atmospheric resistance, as in street railway work, lower the speed at which electric motors of any efficiency become cheaper than steam.

7. In descending to small locomotive units, the electric motor loses less, relatively, of its advantage—another reason for success on street lines.

8. Multiplying the number of motors should be as far as possible avoided

9. In special cases cleanliness and compactness of electric machinery may be of great value; in case of very frequent stops the possibility of returning to the line the energy now wasted in brakes may be of considerable value. This, however, can be obtained only by sacrifice in the matter of dead weight, as normal working is implied to be at comparatively low magnetization. Loss due to low efficiency in starting can scarcely be avoided, either in steam or electric engines.

10. Other minor pros and cons may be enumerated, but I believe that in considering the general economic results of the two systems we reach more definite conclusions.

While only one condition of station working has been taken for final comparison, that case is an average one, and comparative results would be but slightly affected by ordinary variations. Extreme cases may be readily determined from the tables and formulas presented.

11. Some differences of opinion as to the proper values for the various constants are to be expected, but I believe these differences, taken all along the line, would nearly balance between positives and negatives, leaving the general results and the method unchanged.

THE BANQUET.

After adjournment the members reassembled at the Parker House, where they were the guests of the Boston Electric Club. The ample reception room was well filled with the members of both organizations, who spent an exceedingly pleasant half hour in exchanging greetings, renewing old acquaintances and forming new ones. About 200 sat down to a very elegant banquet served in the main dining room of the Parker House. The tables were presided over by Henry B. Cram, president of the club, who acquitted himself most creditably in announcing the various speakers of the evening. On his right sat Past-President Thomson, and President Anthony, and on his left Secretary Pope of the American Institute of Electrical Engineers, and President Pritchard of the New England Gas Engineers association As the occasion was also the closing meeting of the Boston Electric club for the season, a paper was read by Mr. S. E. Barton devoted to the relations between the insurance and electric companies. It was full of weighty arguments supporting the view that electricity was the safest method of artificial lighting. Mr. Barton was frequently interrupted with most vigorous applause. Although no discussion was arranged for, the speakers who followed could not refrain from expressing their pleasure in listening to it. The calls of the chairman were promptly responded to, and all passed off smoothly and pleasantly. Among the speakers were Professors Thomson, Anthony and Nichols, Senator Metcalfe, Messrs. Pritchard, Dumoulin, North, Wetzler, F. L. Pope, R. W. Pope, Capt. Griffin and others The assemblage broke up at about 11 o'clock.

On Thursday, May 22d, the members assembled at the Massachusetts Institute of Technology, where a profitable hour was spent visiting the thoroughly equipped physical laboratories. At 10 A. M. they became the guests of the West End Street Railway company, which had provided carriages in which the members were taken to the great central power station, the massive granite foundations for which are now being prepared Under the guidance of Messrs Mansfield and Dumoulin, the party was escorted through the temporary power house, the car sheds where open cars are being rapidly equipped with motors, and finally to the engineer's department where the plans of this great work had been placed on the wall and thoroughly explained by Engineer Pierson. Places in the carriages were then resumed, and at exactly 11:30 o'clock, two special motor cars, one hauling an open trail car, received the visitors at Park Square. The proposed trip was to Chestnut Hill and return. The weather was perfect, and the excursion was enjoyed most heartily by all who had the good fortune to participate. Every detail of the construction and operation of the Boston electric railways is carefully looked after, and the visitors were enthusiastic over this triumph of electrical engineering.

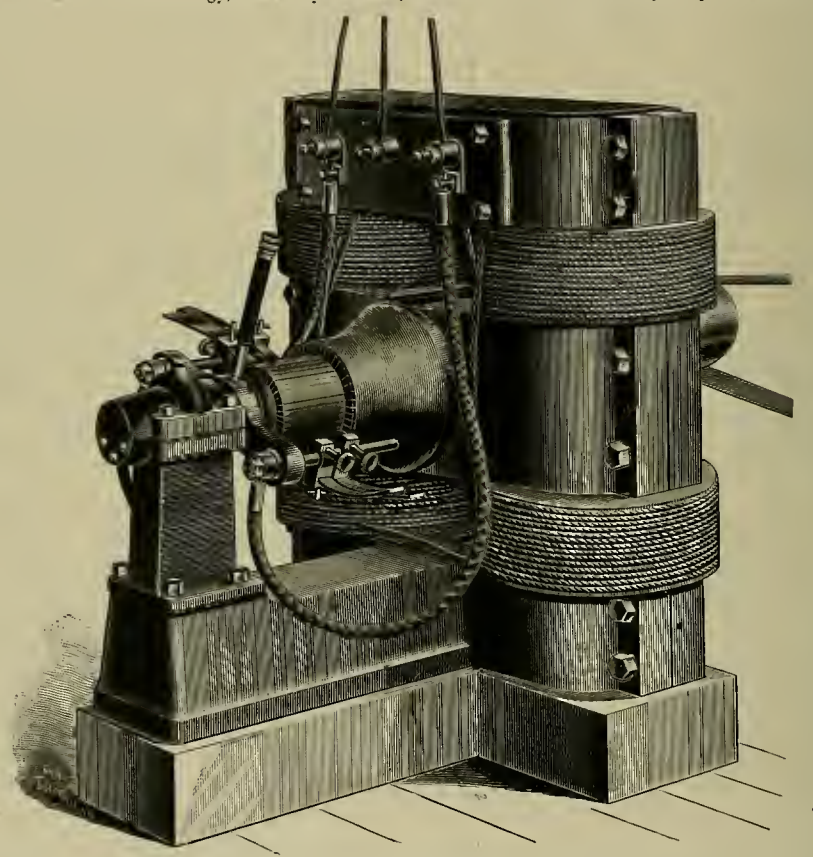
At 12:35 the party returned to the Parker House where a bountiful lunch had been provided. Ample time had been allowed for enjoying it, and as at this point the trip to Lynn was to be entered upon, President Anthony rapped for order, when a hearty vote of thanks was tendered to the West End company upon motion of Mr. Hammer.

Pedestrianism was then resorted to, and at 2 P. M. a special car on the Revere Beach Railway conveyed the party of 60 to Lynn, where three barges were in waiting to carry them to the Thomson-Houston factory. The growth and development of the railway motor, and welding departments since the visit of the National Electric Light association, were particularly noticeable. Ground was being cleared for another addition to the already extensive group of buildings in which 2,600 people are now employed. The welding operations were especially fascinating to the visitors, and it was with difficulty that the scattered groups could be gathered in time for the return train at 4:15. Thus ended the two days spent in Boston and vicinity, the only time wasted, as stated by one of the visitors, being that spent in sleeping.

A Motor-Dynamo.

The accompanying cut represents a 7-horse power motor recently installed in the warehouse of the Chicago Paper company. The motor was designed by Foree Bain, Chicago, and is used to operate a large freight elevator and paper cutting machine. A recent test shows, it is claimed, an efficiency of 95¼ per cent. The field magnet cores consist of two shafts of Norway annealed iron, one on either side of the armature. These are equal in length to the total height of the motor. They are clamped at either end by the double yoke pieces and midway between by very heavy cast iron pole pieces. This construction secures a thorough union between the pieces. The field is the consequent pole type.

It will be noticed the pole pieces are of equal size and weight, and consequently of equal magnetic density. The armature, therefore, is not pulled harder against one side of the bearing than another. It floats so to speak, in a field in which the magnetic lines are equally and properly distributed. The double magnetic circuits are extremely short. The coils are wound on spools, and slipped over the cores. The spools are only three inches long on this size motor. The bearings are self oiling.



A MOTOR-DYNAMO

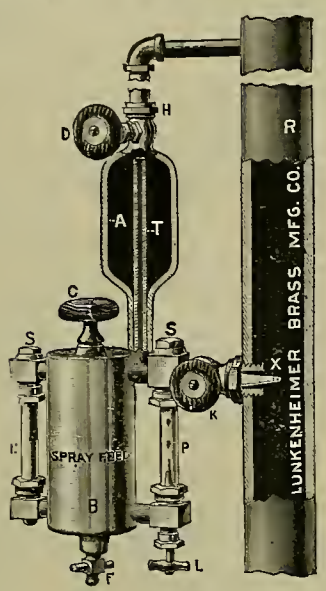
The armature produces 1.4 volts per foot of active wire, with a conductor velocity of 48 feet per second. The field is maintained with less than one-half an ampere. The motor runs quietly and at a very nearly constant speed with variable load.

The designer calls this type of machine a motor-dynamo, not that it is a separate motor and dynamo combined in one machine, but for the reason that it may be used as either a motor or dynamo as may be desired. This type of machine is built in sizes from 5 to 100 horse power.

The Westinghouse Electric company recently sold to an electric company in Las Vegas, N. M., a 500 light incandescent machine and a 40 light alternate current arc dynamo.

Spray Feed Lubricator.

By means of the spray feed lubricator, illustrated in the accompanying cut, oil is forced into *C*, a steam pipe in the form of spray, and thus is atomized and mixed with steam before reaching the parts to be lubricated. This is accomplished by a forcing current of steam which passes through the pipe *T* and out of the spraying nozzle *X*. The device is provided with a needle for guiding the oil drops as they leave the nozzle in the sight feed glass. In applying the lubricator the steam pipe is tapped in two places;



SPRAY FEED LUBRICATOR.

first, for a half-inch pipe for the oil discharge shank, and second, at a point higher up for the condenser pipe. The condenser is connected with the steam pipe by pipe *H*. To fill and operate the lubricator the valves *L*, *D* and *K* are closed; the cup at *F* is drained and filled with oil. The valve *D* is opened and after the sight feed glass *P* is filled with water by condensation the valve *K* is opened, and the dropping of oil is regulated by the valve *L*. The lubricator is manufactured by the Lunkenheimer Brass Manufacturing company of Cincinnati.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 24.—Quite a sensation was produced in this city by the announcement in the daily papers that Walter K. Freeman claimed to be the inventor of the incandescent lamp, and that he openly charged Edison with sharp practice. Mr. Freeman's claims have long been known to the electrical fraternity, but the general public has not been honored with this information. The charge is now made in connection with the suits against the United States company for alleged breach of contract. Freeman goes so far as to state that Edison offered him $50,000 if he would refrain from publishing these statements, and discontinue his claims.

The cable road bill gives the local authorities the right to say what kind of power shall be used on its street railways, and it is to be hoped that the electric companies will take advantage of this fact and establish electric roads in the upper portion of the city, which is now entirely without street car facilities. This is certainly an excellent field for electric roads, and should be developed at once.

The subway fight is at last ended in the filing of a notice of discontinuance of the suits brought against the Board of Electrical Control to prevent the awarding of the subway contract to the Standard Electric Subway company. It is reported that the electric light companies have reached an agreement by which they bind themselves not to endeavor to get control of more ducts in the subway than are actually needed, and inasmuch as any electric light company can get all the subway accommodation it needs by filing the necessary application, with bonds for the performance of the contract, it is not probable that any company is going to pay at the rate of $1,000 per mile per annum for a duct that it does not need.

The meeting of the Board of Electrical Control Monday renewed the contest between Commissioner Gilroy of the Department of Public Works and the Subway company. The board consented at last that the commissioner should begin to repave Broadway at once, and if the additional subway, which is proposed for Broadway, is not down before the pavers get there, the permit to lay it will be revoked. The electric light companies designated which streets they wanted for ducts, and it looks now as if everything rests with the Subway company to complete the conduits at the earliest possible moment in order to give the relief to the city which only good pavements and electric light can secure.

The new quarters of the New York Telegraph club, 32 Cortland street, were formally opened Monday evening. The handsome rooms, fitted up at an expense of $3,000, were thronged with members who thoroughly enjoyed the event. The club's own orchestra, quartet and soloists gave a most delightful entertainment. W. J. Dealy of the Western Union, and G. H. Usher of the Postal Telegraph, made speeches. The club is in a prosperous condition. It lately received a contribution of $1,000 from the Western Union company. The club membership includes Norvin Green, Andrew Carnegie, ex-Governor Cornell, T. A. Edison and George Gould.

A New York syndicate has purchased two street railway lines at Lancaster, Pa., to which electric traction will be applied. W. H. T.

Kansas City, Mo.

KANSAS CITY, May 22.—An interesting meeting was held by the Kansas City Electrical society last week. There was considerable discussion on the subject of insulation for electric light wires, and the erection of other wires adjacent to them. The opinion of the society was that a city official to inspect insulation and construction was absolutely necessary, and the society appointed the following committee to draw up an ordinance to present to the council for the appointment of an electrical inspector: T. F. Clohesy, A. M. Barron and W. H. Woodring. Prof. A. Barrett presented a drawing of his improvement on the Hale fire alarm system and explained it at length. He claims that by his improvement an alarm is transmitted directly to the fire department and registered automatically in addition to the telephone service—one acting as a check on the other and allowing for two channels to transmit the alarm. His system is quite complicated, and may not prove practicable in use although it appears well theoretically. It is proposed to offer the system to the city shortly.

B. F. Hobart, a director in the Missouri, Kansas & Texas Trust company, and president of the Missouri & Kansas Coal company, has telegraphed to the trust company that he has closed the contract for an electric street railway at Pittsburg, Kan., with the Westinghouse Electric company. The trust and coal companies are both interested in the project, and propose to make the Pittsburg lines equal to the electric railways in this city. George H. Clarke, of this city, is now in Boston organizing a party of Boston men for an excursion to Pittsburg, Kan., to reach there Thursday, May 22. A solid train of Pullmans will run through from Boston to the new town. The people of Pittsburg are putting forth every effort to make the 22d a gala day. Excursion trains will also be run from here.

The damage suit of John Higgins against the Kansas City Electric Light company has been dismissed, as it was compromised out of court. Higgins was sitting on a back porch of the Turf exchange on Delaware street one day in the summer of 1888, when he put out his hand suddenly, to save himself from toppling over. He happened to catch an electric light wire, which so badly burned his hand before he could let go of it that two fingers had to be amputated.

About 25 propositions concerning the providing of new quarters for the Missouri & Kansas Telephone company's exchange have been received by W. W. Smith, the company's secretary. No action has thus far been taken, and none will be taken for at least sixty days. The company's officers are not fully determined in their own minds as to what the future demands of the city will be, and they have come to no definite conclusion in regard to the details of the plans for the new exchange. They do not want to go into a new exchange and then find that they have anticipated the necessities for a quarter of a century, or underestimated those of the next two years. P.

Pittsburg, Pa.

PITTSBURG, Pa., May 22.—The Second Avenue Electric Railway company of this city is going to establish a ferry over the Monongahela river between Glenwood and Homestead, in order to accommodate the inhabitants from the latter place and afford them rapid transit to the city.

Superintendent Mead of the Pittsburg Bureau of Electricity is about to make a complete change in the wires of the local police and fire bureau, which will consist in substituting two twisted wires where one is now used to convey the sound.

This alteration will cost $3,000. It has been necessitated by the large introduction of electric street railway wires in this city which have seriously interfered with the telephone lines.

The work on the new electric light plant for Allegheny City is being rapidly hurried to completion. Already there have been thirty-five of the towers erected, and the other seventeen it is expected will be up about the first of June. The one hundred and sixteen mast arms have all been fitted up and will be placed in position at the rate of twenty-five per day. The work at the power house is nearly all done. This is to be furnished with smokeless furnaces and the Roney stoker of Westinghouse, Church, Kerr & Co. The company proposes to burn slack in the furnaces, and the residents surrounding the plant have been assured of an absolute absence of smoke. The lights are to be turned on July 1. The plant will have a capacity of 3,000 incandescent and 540 arc lights. The Westinghouse system is used.

According to advices received from Washington, D. C., Judges Bates, Clark and Stocking of the patent office have just affirmed the decision of Examiners Johnson and Morris awarding priority of invention of the alternating current system of distribution to William Stanley, Jr., of the Westinghouse Electric company against M. M. M. Slattery, of the Ft. Wayne Electric company.

The Thurmound Coal company of Thurmound, Fayette county, West Virginia, is erecting the first electric mining plant in that state. The plant completed will cost about $20,000. The mines will be supplied with electric lights and electric mining machines. The dynamos will have a capacity of 350 amperes of current which is equal to about ninety-four horse power. They are so constructed that accidents to human life will be practically impossible. E. H. H.

Atchison, Kan.

ATCHISON, Kan., May 22.—The Atchison street railway system was sold last November to John Weber of Des Moines, Ia., by W. L. Challiss for $80,000. Last week Weber sold the road to a syndicate for $115,000. Weber retains a one-eighth interest, Challiss takes the same share, while the remainder of the stock is owned in Boston by men who are represented by H. J. Ranson of Des Moines, who is also one of the syndicate. The transaction was a cash one. It is the intention of the new company to change the motor power as soon as possible to electricity. Within 30 days the work will be in progress. The South Fifth street line will go to Midland college, or close to it, and the North Fourth street line will wind around the hills into the thickly settled community north of Division street. The Tenth street line will be extended as far as the buildings extend on that street, at least six or eight blocks northwest of its present terminus. An expert will be sent here by the company within the next two weeks to decide just where the extensions will go, and to make arrangements for the relaying of the tracks. He is now superintending the construction of a line at Keokuk, Ia. The overhead wire system will be adopted but it is not probable that cars will be operated by electricity before September. The Sprague system will be adopted. R.

Plattsmouth, Neb.

PLATTSMOUTH, Neb., May 22.—At a recent meeting of the Plattsmouth Gas & Electric Light company the capital of that concern was considerably increased. The purpose of this was made apparent Saturday evening at a joint meeting with the Plattsmouth Electric Lamp company when a proposition was made and agreed to by both parties which resulted in the purchase of the land, the power house building, the engines, boilers and dynamos used in furnishing electric light for the city, for the sum of $7,500. The result of this purchase is that the whole electric light property, together with the power, will be in the hands of the Gas & Electric Light company, of which J. G. Rickey and C. D. Jones are the principal stockholders. Contracts were also entered into for furnishing power for the electric lamp works and to the dynamos of the motor car company. M.

THE ELECTRIC LIGHT.

The Central City, Ky., Lighting & Power company has applied to the legislature at Frankfort for a charter.

The Johnson City, Tenn., Electric Light company has purchased new buildings and will install an entirely new plant.

The Cardiff, Tenn., Iron & Coal company has awarded a contract to the Thomson-Houston company for an electric light plant.

The Westinghouse Electric company recently sold to a newly-formed company in Youngstown, O., a 2,250 light incandescent plant.

Los Angeles, Cal., is to have an electric lighting plant of the Westinghouse alternate current system of 1,500 16 candle power lamps. The work of construction is to begin immediately.

The National Electric Manufacturing company of Eau Claire, Wis., has secured contracts at Asheville, N. C., for 100 arcs and 1,000 alternating incandescents, and at Anderson, S. C., for 750 alternating incandescents. The 900 light direct current plant which the company is installing in the Hotel Normandie in Washington, D. C., will be in operation in a short time.

In an article in the St. Louis *Globe Democrat* on the lighthouse the following in regard to electric light appears: Many experiments have been made with electricity for lighthouse purposes, but they have not been entirely satisfactory. Several years ago the government erected a skeleton iron tower at Hell Gate—the tallest lighthouse on the coast. The height was 255 feet. Nine electric lights, each of 6,000 candle power, were placed at the top. As a show the tall tower was magnificent. The iron work could not be seen and the lights seemed to be suspended in the heavens. But instead of showing up the intricate and dangerous channel this grand illumination blinded the pilots. The latter could see nothing beyond a restricted circle. On the petition of those who had originally asked for this lighthouse it was abolished. The tower was sold for old iron and was thrown down by dynamite. The electric lights on the statue of Liberty on Bedloe's Island in New York harbor can be seen twenty-five miles out at sea. But they are no part of the lighthouse system. In the narrows the channel is marked by two lines of buoys. These buoys are made of juniper, one of the best woods to float. The logs are 45 feet long. A cast iron sinker weighing 4,500 pounds is fastened to the butt, and that makes the log stand at an angle in the water. The top is made conspicuous and is also protected by a cage, in which is an electric light. A strong cable connects with the buoys, and when the electricity is turned on at the Sandy Hook plant the double line of buoys is lighted up. The lamps on one side have red glass. Driftwood or ice may run over the top of these buoys and carry them below the surface of the water, but they bob up again, cage, light and all, ready for duty. The same apparatus which serves the buoys with a current also lights the beacon at Sandy Hook. This is the extent to which electricity is now used in the service.

THE ELECTRIC MOTOR.

An electric road between Cornelia, Ga., and Demorest will be constructed.

It is reported that the City Land company will construct an electric railroad at Columbus, Ga.

Lansing, Mich., is to have an electric street railway which will be built by the Westinghouse Electric Railway company.

It is stated that the Nashville, Tenn., Electric Railway & Power company will commence the construction of its road as soon as the right of way can be secured.

The Home Electric Railway company, Macon, Ga., has been incorporated by R. F. Lawton, R. L. Henry, W. A. Doody, W. B. Sparks and others, for the purpose of constructing an electric railroad. The capital stock is $50,000.

The franchise for an electric street railway at North Yakima, Wash., has been granted by the council to Wayne Ferguson, L. MacLean, C. V. Massey and others of Spokane Falls, who have recently been investing largely in Yakima property. The work is to begin at once.

The Austin and Travis County Rapid Transit company has been incorporated at Austin, Tex., and will build an electric railroad. The Austin City railroad company will, it is reported, at once double-track its main lines and extend its road about eight miles, the road to be operated by electric power.

The Westinghouse Electric Railway company is now building an electric railway at Pittsburg, Kan. Through the business portion of the city there will be a double track, with a single track for the suburbs. Materials for the track are on the ground, cars and machinery will be ready when the track is, a handsome station is to be erected, and the whole work will be energetically pushed to completion.

The following expression of fear was uttered by a resident of St. Louis: The electric cars now running in the city sometimes go at a speed which is somewhat alarming, and if this continues when the systems are extended down town there will be trouble. Some years ago, when steam locomotives were first allowed on "tramways" in Europe, popular prejudice was overcome by a brake which applied automatically the moment the speed exceeded the maximum allowed by law. Such a safeguard on electric trains would do away with much opposition, and probably prevent much loss of life.

D. J. Whittemore, Chief Engineer of the Chicago, Milwaukee & St. Paul Railroad company, is authority for this story: When the electric cars were first introduced in Milwaukee they created considerable attention. While the system was being tested and trial trips made, a resident of the Cream City, who was watching the experiments, said he didn't believe they had yet conceived the correct idea about running electric cars. That overhead work be thought not strong enough. "You can't expect," he said, "to get good service while you depend on such flimsy construction. Instead of a wire, they ought at least have a bar nearer the size of a rail, and a driving wheel would do much better service than that trolley wheel. That's my idea." Mr. Whittemore recommended the possessor of this idea to lose no time in applying for a patent upon it.

Judge Reilly, of Detroit, has given a decision against the residents of Mack street, who have been opposing the construction of an electric railway on the street. Secretary Currie, of the Detroit City Railway company, announces that in the event of the Supreme court affirming Judge Reilly's decision in the Mack avenue case the railway company will at once take steps to introduce the single trolley electric car system on all their lines in this city. Some months ago the company engaged an expert engineer in England to make a thorough investigation of rapid transit, and recommend the best system. This engineer reports that the storage batteries which have been in use in Brussels for four years past have been abandoned, because the expense of charging the batteries and keeping them in repair exceeded the receipts of the cars. Nevertheless, Mr. Currie says his company is ready to give Detroit's storage battery a trial if the promoters will guarantee its successful operation. W. W. Humphrey said yesterday that the storage battery company would make the Detroit City Railway company a definite proposition next week, and it is understood that they will give a satisfactory guarantee. The works of the motor company have been removed from Howard street to Franklin street.

Personal Mention.

F. B. Badt, superintendent of construction of the Leonard & Izard company, Chicago, has just returned from an extended Western trip.

W. E. J. Deming has been appointed city wire inspector of Minneapolis. C. C. Haskins of Chicago conducted a competitive examination of applicants for the position—12 in all—and found Mr. Deming well qualified for the position.

THE TELEGRAPH.

A police patrol system has been decided upon for Georgetown, D. C., and the contract for the construction and electrical equipment will soon be awarded.

It is said that the Western Union will build a line from Seattle to Blaine, Wash. The Great Northwestern will take it up there and carry it to Westminster and Vancouver, whence a cable will be laid to Nanaimo and a wire strung from there to Victoria. It is likely that a line will be built to Port Angeles.

THE TELEPHONE.

During a storm at Friend, Neb., on the night of May 11, the lightning ran into the telephone office and caused a fire which destroyed the telephone apparatus. A. E. Moeller, the superintendent of the telephone office, has gone East to arrange for a new switch-board.

According to a Dublin dispatch, the telephone has been playing an important part in English politics. The cablegram says: The *Freeman's Journal* exults over a trick that was played upon the Conservatives Wednesday while a division was impending in the House of Commons on Mr. Russell's motion to adjourn the debate on the Irish Agricultural Laborers' bill. It appears that when the Conservative whips went to the telephones to summon a long list of members from the clubs for a hurried division, they found the instruments in possession of Parnellite members, who held conversations over the wires with fictitious friends until the division bell rang, when of course it was too late for the whips to secure the aid of the missing members, the stratagem of the Parnellites defeating the government on the motion to adjourn. Mr. Balfour allowed the bill to go to a second reading without a division.

Miscellaneous Notes.

Madison Buell says: "A dynamo is sometimes called a generator. It generates nothing."

The Rockford (Ill.) Electric Manufacturing company has increased its capital stock to $100,000.

It will be remembered that on the occasion of Henry Villard's visit to Minneapolis he promised the business men of the city that the Edison electrical exhibit, now displayed at the Lenox Lyceum in New York city, would form one of the attractions at the Minneapolis exposition next fall. A Minneapolis paper prints the following dispatch from New York in regard to the exhibit: All the details and arrangements for the Edison display, containing almost everything that was in the display at Paris and several additional exhibits which recent inventions have enabled them to make, have been satisfactorily completed and the display that will be made at the Minneapolis exposition this fall will be the very finest electrical display that has ever been made up to date, and will be under the personal care and supervision of experts from Mr. Edison's laboratory. One feature alone requires 7,500 incandescent lamps, of various colors, which will be arranged so as to keep time to the music of the band in the exposition, and a phonograph containing records and speeches talked into them by distinguished statesmen, artists, singers and people of prominence all over the country, will be included in the exhibit. The Edison company and the gentlemen in charge of the various departments have entered most heartily into the plan, and have promised Mr. Regan the most attractive features of their various departments.

In referring to the opening of a permanent chemical exhibition at Manchester, the London *Electrical Engineer* says: "But perhaps the most novel and interesting exhibit is that of Ernst Fabrig, St. Helens Ozone Works, Plaistow, of ozonized products produced by the generation of ozone by means of electric currents. Esparto pulp is shown bleached by the ozone manufactured by this method. Where this agent is employed, absolute whiteness and fixity is assured; in fact, an imperfectly bleached material will become whiter by standing, as though the residual ozone were slowly spending itself, and gradually bleaching the fibers. Ozonized water is shown, suitable for killing microbes and for sterilizing purposes generally. Ozonized oil is used in medicine and in the preparation of linoleum and floor cloth. A further specimen shows what is called 'ozone ammoniated lime,' the peculiarity being that a considerable quantity of nitrogen is said to be fixed in combination with the lime, and 'ozone oxidized mangan,' a high oxide of manganese, is formed by the action of ozone on a lower oxide. A bleached solution of sugar is shown, the liquor of which, before treatment with ozone, was jet black. The bleaching may be performed either before or after boiling, and is also applicable to dry sugar of all grades. We may mention that the electrical production of ozone in immense quantities, evidently capable of many important chemical applications, is receiving considerable attention from chemists and electricians both in this country and on the Continent."

Columbia College, New York, has just issued a "circular of information" about its school of mines. This so-called "circular" contains more than 100 pages of printed matter, but much more than that would be required to give any idea of the good work that is being conducted at that excellent institution. Its electrical engineering course, under the direction of Prof. Francis B. Crocker, has become one of the most important branches of the institution. It covers every department and occupies two years, including experimental work and shop practice. A graduation thesis on some special electrical subject will be required at the end of the second year. Students who desire the degree of electrical engineer will be required to pass examinations, at the end of the course, in the general construction of boilers, engines, and other machinery, and in the principles of dynamics of engineering and thermodynamics relating to the same if they have not already pursued these subjects in a previous course of study.

During both years the students will have workshop practice in the actual making of electrical apparatus. Frequent visits will be made to electrical factories, stations, and plants, and weekly evening conferences will be held on current electrical literature. Graduates of colleges and technical schools, and other applicants of adequate attainments and mature age, who are not candidates for a degree, may be admitted to partial courses on giving satisfactory evidence to the faculty that they are able to pursue with credit and advantage the special topics or studies to which they wish to devote themselves for one year.

Business Mention.

The McCreary Electrical Specialty company of New York has succeeded to the business of Alfred A. McCreary.

The Bishop Gutta Percha company report exceedingly large orders of late. The East River Electric Light company will use this cable in Broadway and Houston streets. It is giving general satisfaction.

Harry Baum, vice president of the Fidelity Carbon company of St. Louis, spent last week in Chicago, introducing the arc light carbons made by his company. He reports a very good business and good prospects for large sales in the near future.

The Detroit Electrical Works report a new contract closed up by them in Fort Worth, Texas, for what is known as the Sylvania line owned by E. C. Chase and others, and will equip it with the Frank B. Rae system as soon as the track is completed.

The Electro-Dynamic Company of Philadelphia has issued a neat catalogue and price-list, which is of interest to the trade. The company makes a specialty of direct incandescent lighting, storage battery lighting, and arc lighting, and manufactures electrical measuring instruments and general electric supplies. Its electric cars are also favorably known, and its electric drills are in use by the Government.

One of the largest orders for belting that has been awarded in the West during the year was that in connection with the street lighting plant at St. Louis. Two main driving belts, 48 inches wide, and 1,600 feet of dynamo belts were supplied by the Munson Belting company. This company also secured the order for two 44 inch three ply belts, 139 feet each, from the American Wire Works, Cleveland. Both contracts were secured through the Chicago office, of which J. H. Shea is manager.

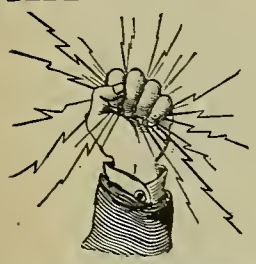
Geo. Cutter was very busy last week moving his large stock of electrical supplies from his late store at 80 Adams street to the new headquarters of the Great Western Electrical Supply company at 190 and 192 Fifth avenue, Chicago. In addition to this large stock orders have been placed with the manufacturers for one of the largest stocks of electrical supplies that has ever been brought to the city of Chicago. Mr. Cutter's business for the past year has shown month by month a most gratifying increase, and the new company will at once take a high standing in the electrical interests in the west. The new stores to be located in a number of the western cities, will be rapidly gotten in readiness, and within a very few weeks the company will be prepared to handle all the business that may come in. The new store at 190 and 192 Fifth avenue is admirably adapted to this use. It has five floors well lighted and well ventilated, with basement, and unusually good facilities for prompt and rapid receipt and shipment of goods. It is possible that some light manufacturing may be done on the upper floors in the way of small specialties. The offices will be located on the second floor and will be handsomely finished, and the appointments will be first-class in every respect.

A Detroit paper says: "The largest contract for electrical apparatus ever given out in this city has just been let by Daniel Scotten for the new Cadillac Hotel to the Fisher Electric company. The amount of electrical work to be done involves an expense of nearly $5,000, and it is plain to be seen that Mr. Scotten is determined that the new hotel shall be thoroughly equipped with a very complete outfit of the apparatus found so necessary in buildings in these modern days. The securing of such an important contract is decidedly a gay feather in the cap of the Fisher company, a comparatively young company, but a decided hustler. Guests at the new Cadillac can rest assured that in the way of illumination, fire alarm and call bells, they will have nothing to ask for. Here is the list: First come 1,500 incandescent lights, the wiring to be done for the Edison system. Then there will be a 350 number annunciator. Then there are 356 return call bells, followed by 350 mercurial fire alarms. There will be fifty 12-inch alarm gongs to be placed in the hallways, and a 25-station watchmen's time detector. Watchmen will be stationed in the halls, and at stated intervals will push a button notifying the office that they are attending to duty and not asleep. Any failure to signal would result in a passe to find out what was the trouble. The Grimshaw white core wire will be used, and taken altogether it will be the most complete electrical outfit ever put into a building in this city."

The Illinois Electric Material company has been recently incorporated and has opened offices at 341 Rookery building in this city. This company will do a general electric light and power supply business and will carry a large and complete stock. Their storeroom is located in the basement of the Rookery building and is large and accessible, and the stock to be carried will comprise everything necessary to the erection and maintenance of electric light and power plants of all kinds. H. S. Winston, the president, is well known in Chicago, being formerly of the firm of Ferguson & Winston, which has been in the insurance business in this city for many years. Ernest Hoefer, the vice-president and manager, was formerly connected with the Electrical Supply company of this city, and for the past year has been the agent of the Bishop Gutta Percha company of New York. In this line he has been very successful and has secured a large business in the celebrated Bishop white core and other wires. Some months ago Mr. Hoefer completed arrangements for representing the Trinidad-Heimann wire, and has already placed many large orders for this specialty. E. L. Clark, the secretary, has for the past year been the western agent of the Walworth Manufacturing company of Boston, and has also made a specialty of handling telegraph and telephone poles, as well as ties for electric railways. The company starts out with every assurance of success, and will doubtless soon command a large share of patronage from the electrical fraternity.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



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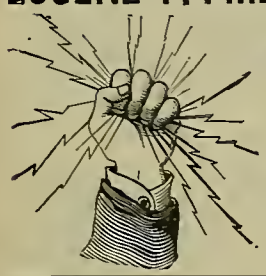

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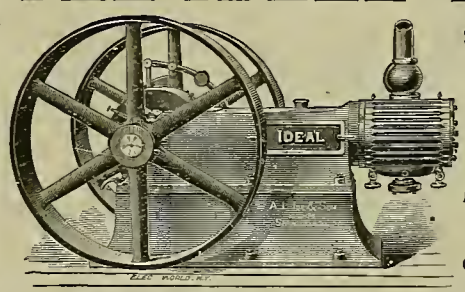

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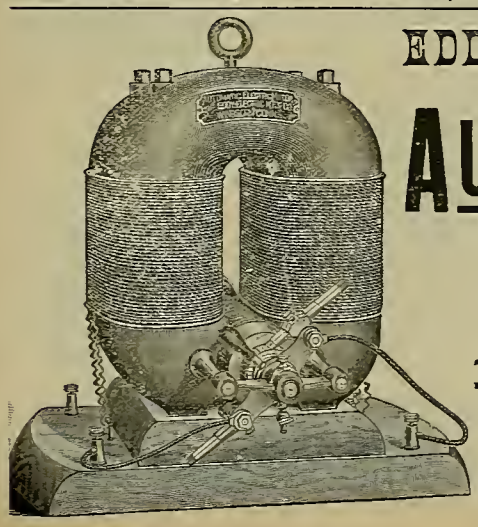

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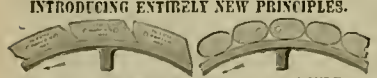

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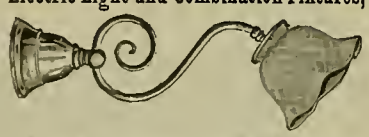

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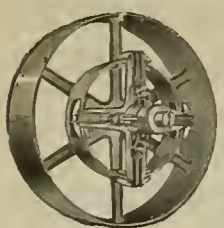

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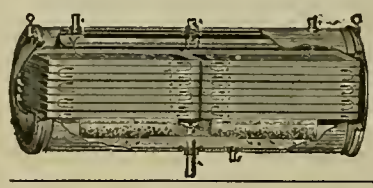

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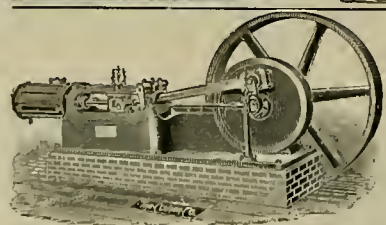

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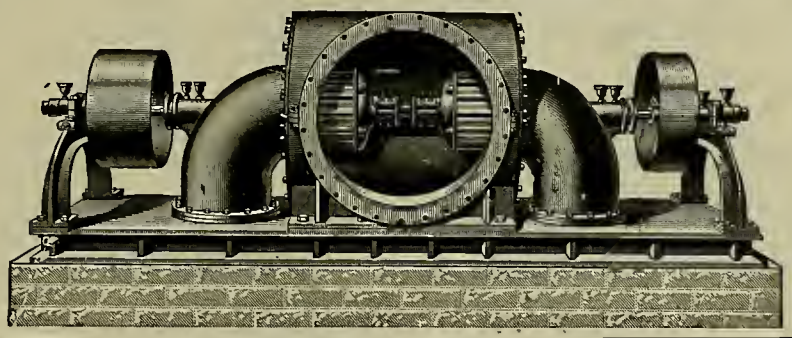

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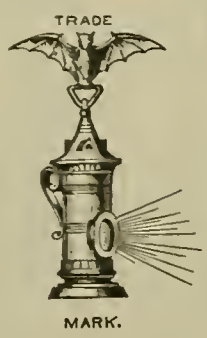

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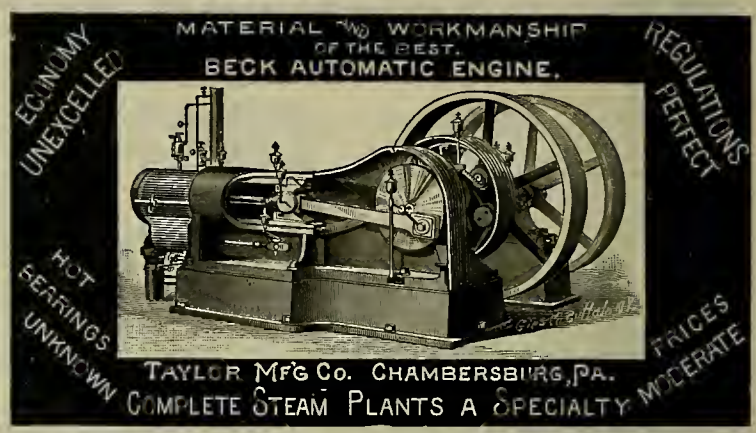

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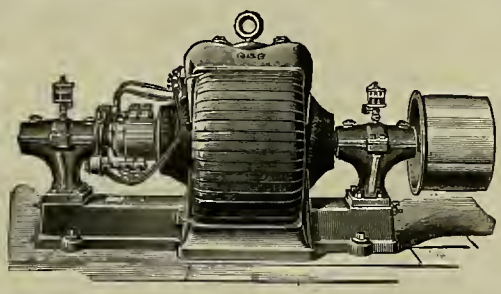

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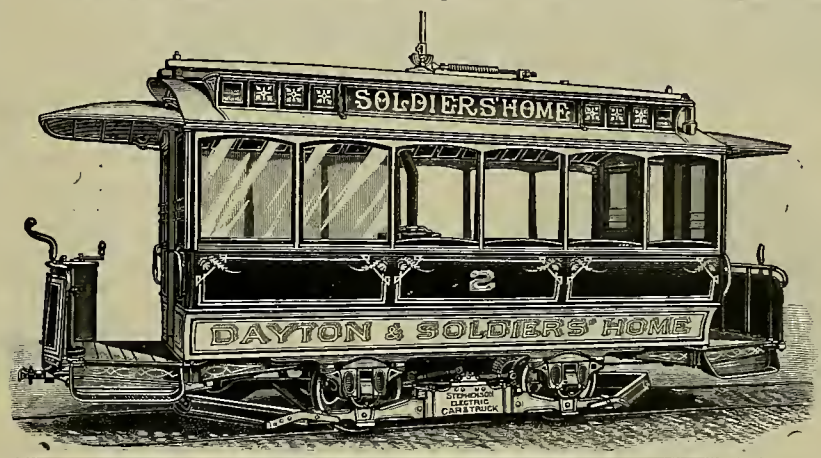

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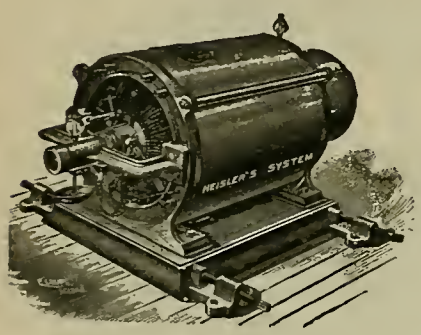

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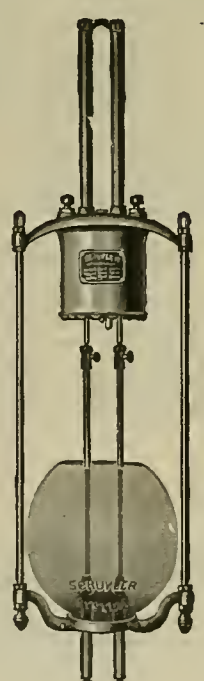

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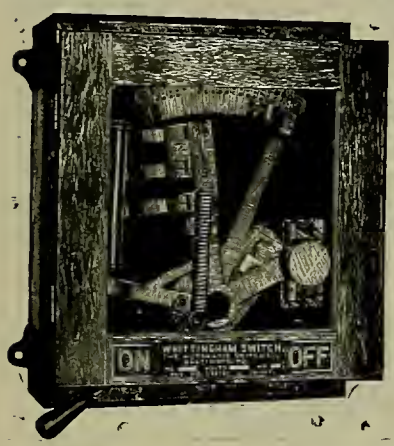

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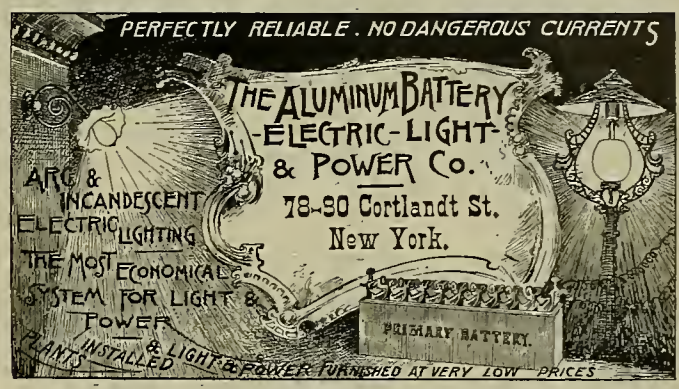

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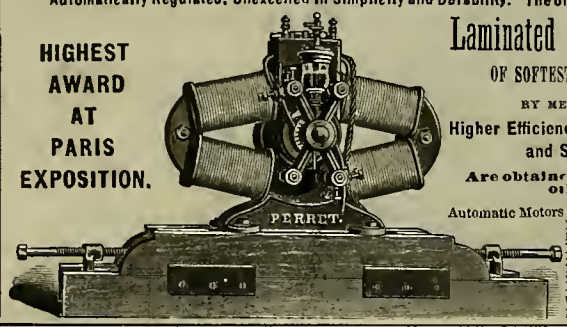

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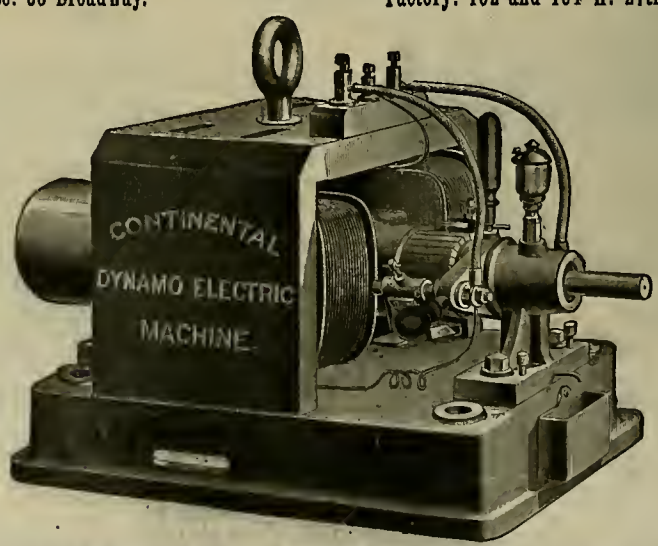

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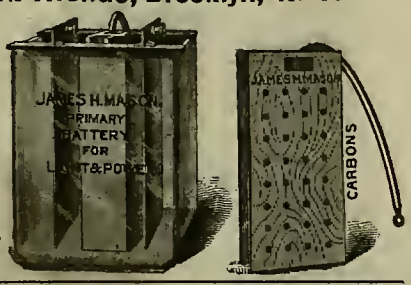

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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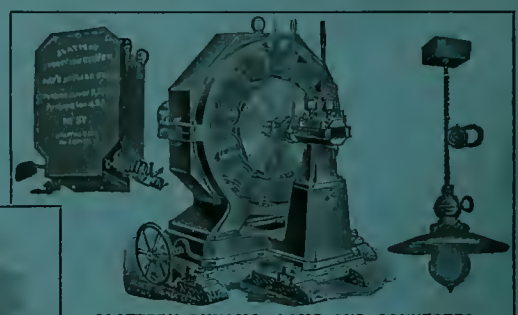

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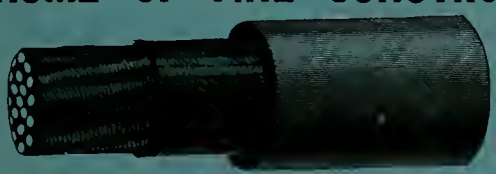

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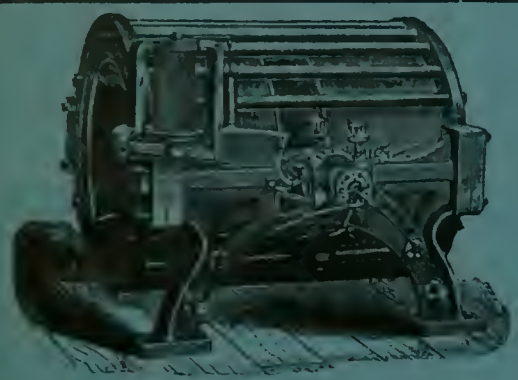

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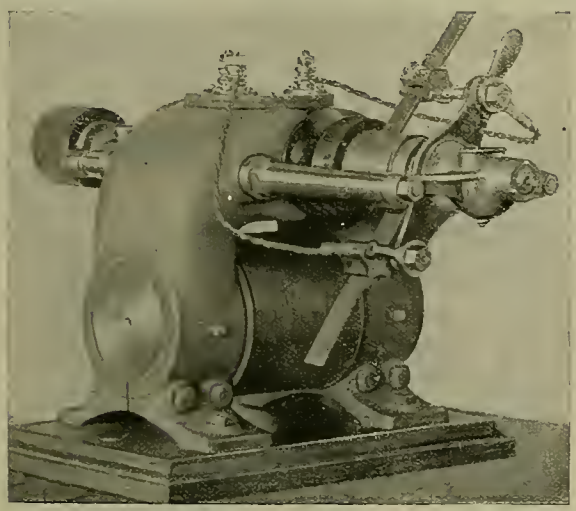

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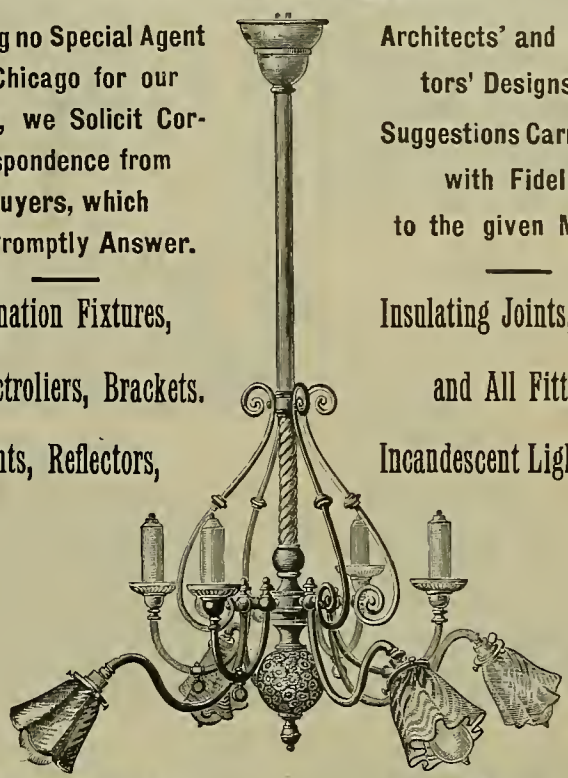

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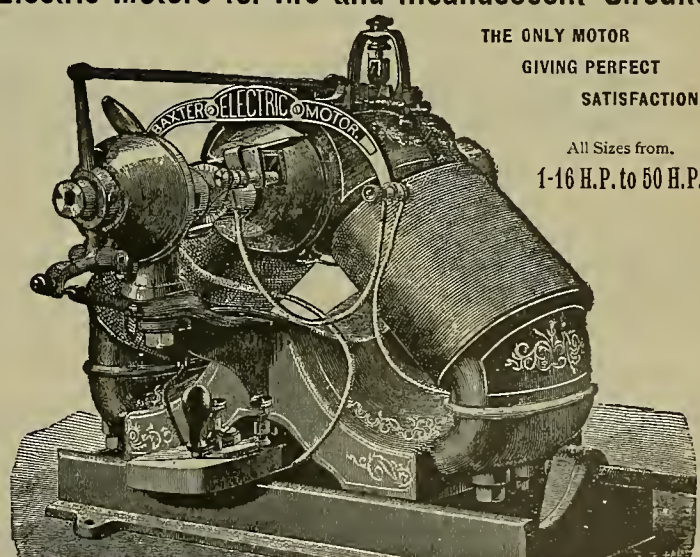

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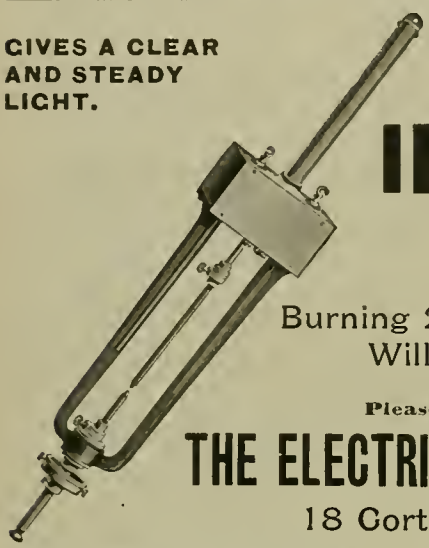

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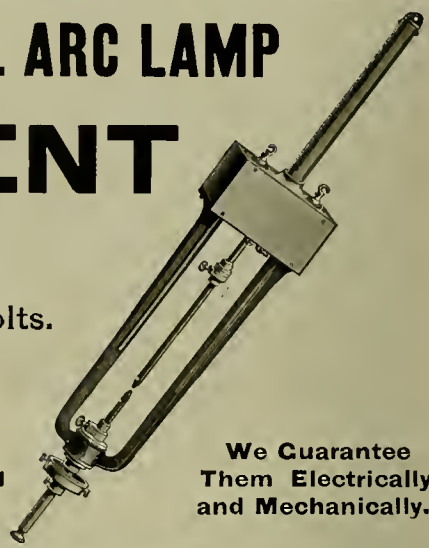

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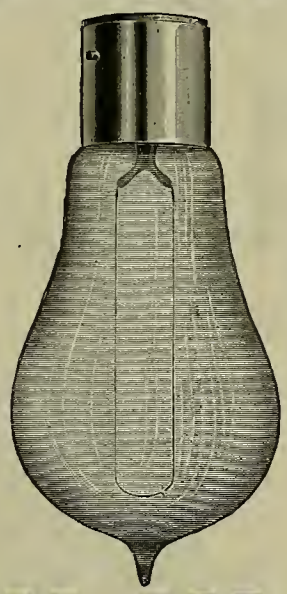

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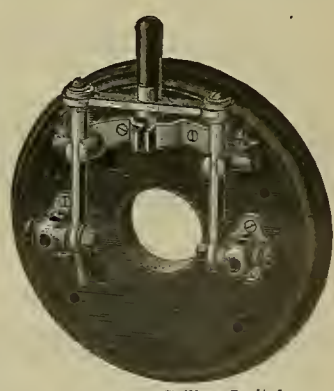

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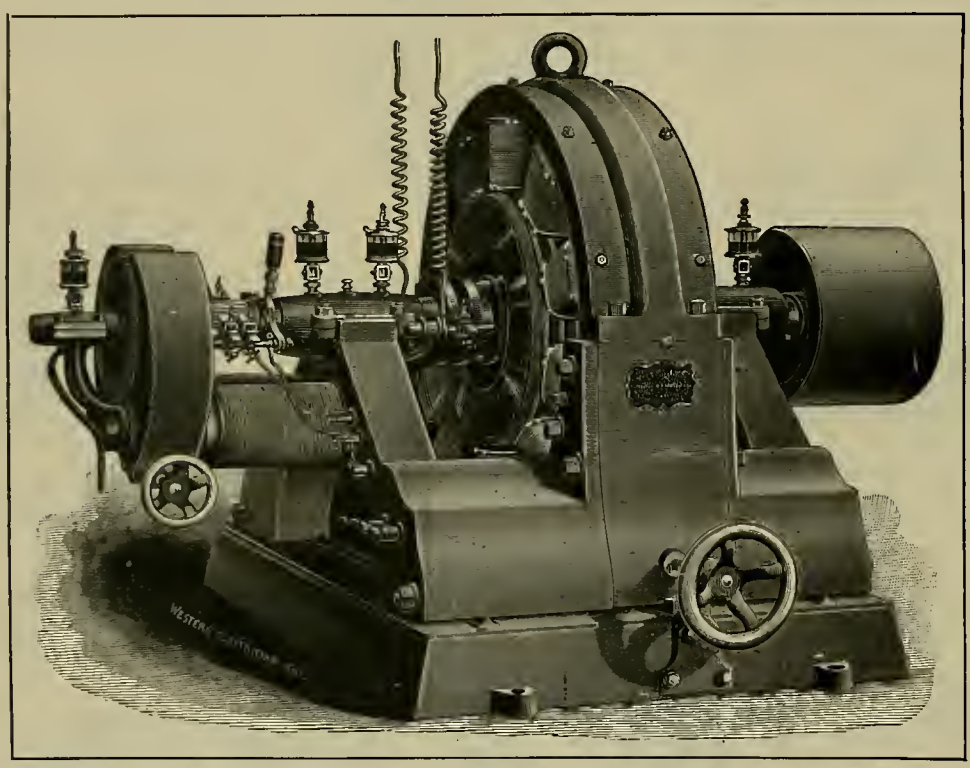

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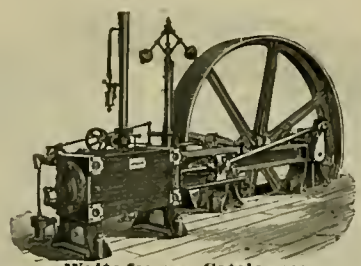

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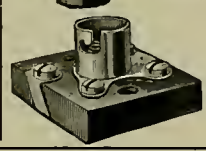

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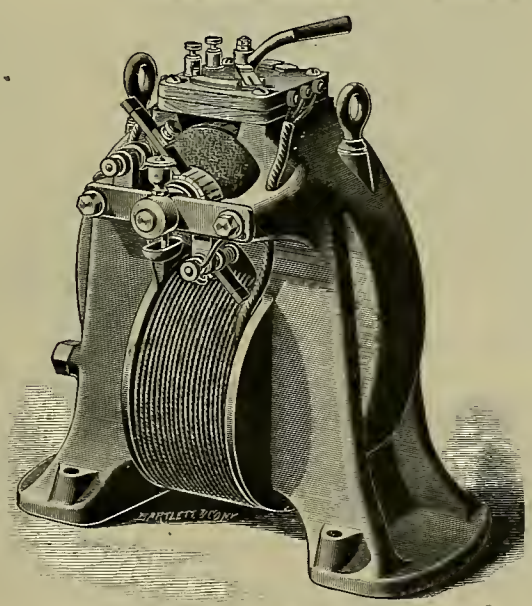

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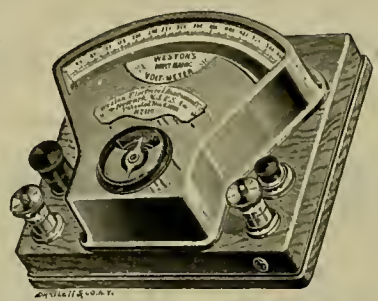

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ACCESSIBILITY—Perfect access to concealed wires.
ECONOMY—Small cost of installation, and freedom from future expense.
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CONVENIENCE—Systems of electric wiring may be laid out on original plans in a manner similar to that employed for gas, water and steam piping; the conductors may be drawn in at pleasure.

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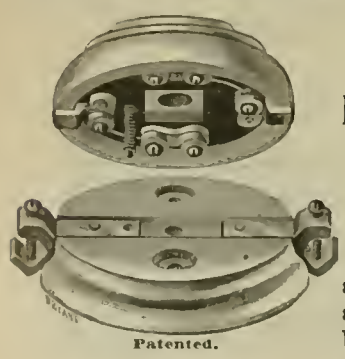

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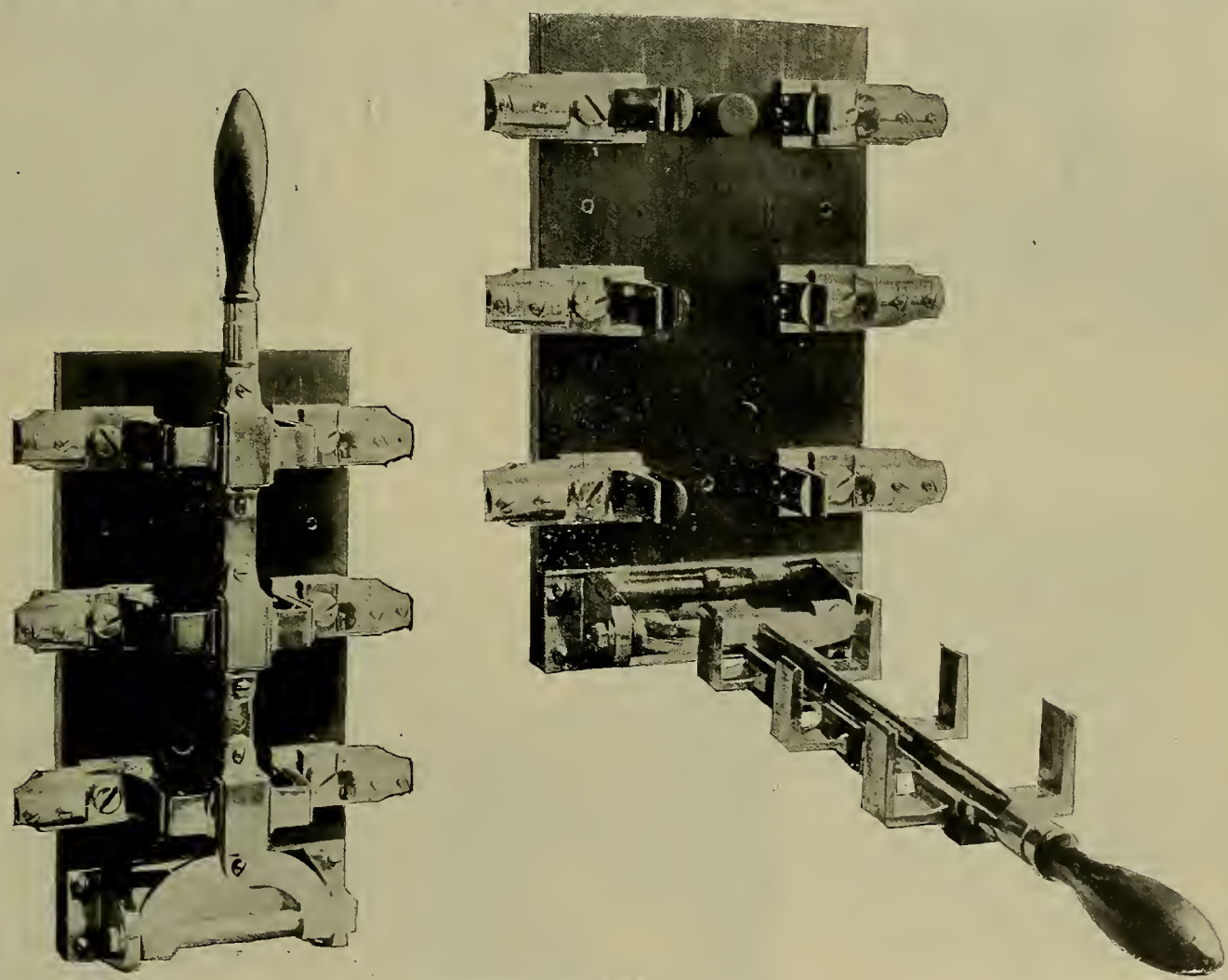
Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, JUNE 7, 1890. No. 23

One-Movement Switch for Railway Dynamos.

Where compounded machines worked in parallel are used to supply current to railway circuits, unless care is taken in starting to make the connections in a certain definite order, there is a liability to accident. To prevent trouble which might result from the carelessness of an attendant in thus coupling generators in multiple, Frank B. Rae of Detroit, has designed a special form of switch, which operates in such a manner that all connections are made by one movement and in the proper order. This switch,



ONE MOVEMENT SWITCH FOR RAILWAY DYNAMOS.

illustrated in the cut, was designed by Mr. Rae especially for service in the system which is now being exploited under his name. The design being exceedingly simple, will be readily understood. The switch is substantially built and so constructed that good rubbing contacts are insured.

Burying Telephone Wires in San Francisco.

The wires of the telephone exchange of San Francisco will soon be buried. The company has been making numerous tests, and is thoroughly satisfied with the results. E. M. Jackson of Chicago will have charge of the work of burying the wires. His experience with the Chicago Telephone company will be of great value to him in the new project. He is now in the East examining the details of the systems of Boston and New York, and he will combine the best features of these with the Chicago system in the new plant. While passing through Chicago the other day, Mr. Jackson informed a representative of the WESTERN ELECTRICIAN that he expected to have ten miles of wire buried in San Francisco within a year. "The Telephone company's wires in the business district," he said, "will all be placed underground as soon as possible. We will push the work as rapidly as conduits can be built to receive the cable. The San Francisco exchange is one of the most important in the country. It now has 4,000 subscribers and the field is not yet fully worked. Then again, the town is growing and it is bound to be a great city—all of which means increased prosperity for the telephone company, and all other electrical interests for that matter."

The present condition of electric lighting and motor interests on the coast is a surprise to all electrical people from the East. Electric lighting is practically in its infancy there—in fact, it has not yet got a good start and the motor business is insignificant. At present, however, there is a stir in all branches of the electrical industry, and the electric lighting and motor fields will no doubt be thoroughly developed. Coal is very expensive in the coast region and this explains in part the failure of capitalists to go into electric lighting and power companies where there is not abundant water supply.

"It is remarkable, however," said Mr. Jackson, "how the small towns between Chicago and the coast region have taken to electric lights and street cars as well as the motor business in general. Every town feels it a duty to have half a dozen arc lamps on its 'Main street,' or about the town hall or pump, and wherever a horse car line can be supported the electric motor must be substituted. In all of these towns there is great local pride in these public works, and they are the subject of no little blowing and puffing. I believe the coast will soon be well supplied with electric lights and every other department of electric development will be as well represented."

Advancing Prices of Belting.

It will be of interest to electric lighting and power companies to know that, at a meeting of the belting manufacturers of the United States, at the Auditorium hotel, Chicago, last week, it was decided to notify all dealers that prices would be raised and that the new list would go into effect on July 1.

Device for Locating Flaws in Shells.

In certain industries it is exceedingly important that means be found for detecting slight flaws in metal below the surface. This is especially true in the manufacture of shells, in making which defects are liable to occur, inasmuch as the steel is rapidly tempered. Nothing on the surface indicates the existence of these so-called fissures within the shell. When the metal is tapped by a hammer unquestionably different sounds are given out by the perfect and imperfect portions, but the ear is not a sufficiently delicate instrument to detect slight changes in sound caused by minute internal flaws.

Captain Louis de Place, professor of fortification and applied science in the cavalry school at Paris, has utilized the microphone for discovering these little internal fissures in metals. He combines the microphone with a mechanical striker and a phonometer, and has designed an instrument which he calls a schiseophone. The principle of the device is simply this: When the striker makes a blow against the shell, a person by means of the microphone is able to determine by the sound the point at which a flaw in the metal may exist.

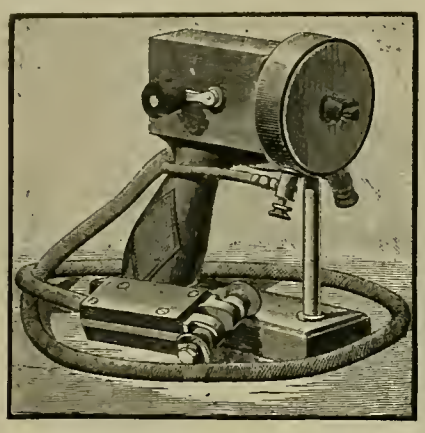


FIG. 2. DEVICE FOR LOCATING FLAWS IN SHELLS—MICROPHONE AND HAMMER.

In Fig. 1 is illustrated the method of testing a shell. The operator at the left has in charge the striking apparatus and the microphone. The operator at the right is located in an apartment called the "hearing room." The principle underlying the instrument is shown in diagram Fig. 4. *B* is a block of metal to be examined, in which it is supposed that the flaw, *t*, exists. A circular microphone of special form and construction is used, and on its face is a striker *F*, which is worked by a very simple mechanism, not shown in the cut. The battery is put in circuit with the microphone and a coil *B*, fixed at the zero point on the graduated scale *R R'*. Upon the scale a second coil *B'* can be moved, and in circuit with the latter coil are two telephones, which are held, as shown in Fig. 1, by a little head piece at the operator's ears.

It is plain, if the little hammer strikes a blow upon the sound portion of the shell, such as *p p'*, Fig. 4, the coils being in contact, the telephone will yield a certain sound which will decrease as the operator separates one coil from the other. At a given point there will be entire silence. Now if the examination with the striker is continued, and the fault *t* is reached, the little internal fissure or cavity will act as a sort of minute sounding box. A sound will be heard in the telephone, and the fault can be located.

The instrument is contained in a box of four apartments, which contain, first, the scale with its two coils; second, the telephones; third, the striker and its microphone, and fourth, six dry batteries. *La Nature*, from which the cuts were reproduced, states that a number of interesting tests have recently been made with the instrument at Ermont. A considerable number of rails were tested, and faults which were found in them were indicated with red paint. Subsequently the rails were broken, and it was ascertained that at the points indicated, flaws more or less serious existed.

A 450 light incandescent plant has been installed by the Chicago Edison company in the sugar refinery at Twelfth street, Chicago. This plant is an addition to the 250 light plant already in operation at the refinery.

Phonograph Convention.

A conference of enthusiastic phonograph men was held at the Auditorium hotel, Chicago, Wednesday and Thursday of last week. The gathering included representatives of the North American Phonograph company, of companies

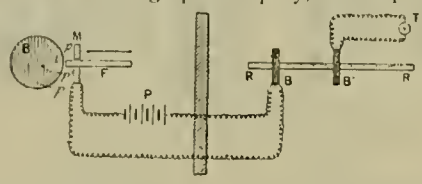


FIG. 4. DEVICE FOR LOCATING FLAWS IN SHELLS.

holding franchises from that corporation, and of Thomas A. Edison. The object of the gathering was general. The representatives met to consider matters relating to the general policy of the companies, to devise means for introducing the instruments into more general use, and to make suggestions to the parent company in reference to improvements in the machines. Topics of this nature were discussed in the meetings, which lasted from early morning until late at night. The reports of the meeting were recorded the first day by the phonograph-graphophone, and the second day by the improved phonograph with excellent results.

The reporter of the proceedings talked his record of the meeting into his instrument. As a speaker addressed the meeting the reporter repeated the remarks in a low tone, so low, in fact, that his voice was inaudible a few feet away from his desk, but loud enough to make a phonogram. The words which were recorded on the phonograph cylinders can be put on paper by the typewriter whenever it may be desirable. "There will be no danger that his notes when cold cannot be transcribed," remarked one of the attendants at the convention. The phonograph men made a great point of this method of reporting proceedings. It has been stated that it would be necessary to speak so loudly that the reporter's voice would disturb a meeting. This belief was disproved by the success which attended the use of the instrument last week. Again, whenever it is desirable that a written report of proceedings shall be completed as soon as an adjournment takes place this is easily accomplished. The reporter turns over his phonograms to a typewriter or a number of typewriters, if necessary. The latter can keep up with the report, and have it finished almost at the moment that the last word is spoken in a meeting. Several stenographers who, as stockholders of phonograph companies, were present were delighted with this means of reporting the proceedings of a deliberative body.

Following is a list of the companies represented and their representatives:

North American Phonograph company, Jesse H. Lippincott, New York; American Graphophone company, Washington, Col. J. G. Payne; Samuel Insull representing Thomas A. Edison; Alabama Phonograph company, Chas. A. Cheever, president; Kansas Phonograph company, Geo. E. Tewksbury, president; Chicago Central Phonograph company, Mr. Holt, E. A. Benson, Mr. Dickinson; Michigan Phonograph company, Mr. Freeman, manager, Mr. Swift, secretary; Old Dominion Phonograph company, J. H. McGilvra, president; Tennessee Phonograph company, J. Balleras, president; Georgia Phonograph company, J. C. Clarkson, president; Texas Phonograph company, H. Sellers, president, Thomas Conington, general manager; Ohio Phonograph company, Jas. L. Andem, president; Wisconsin Phonograph company, H. D. Goodwin; Minnesota Phonograph company, C. H. Chadbourne; Missouri Phonograph company, J. C. Wood, W. J. Morse, Geo. L. Wood, W. Clancy, vice president; J. C. Elliot; New England Phonograph company, A. N. Sampson, president; New York Phonograph company, John P. Haines, president; Metropolitan Phonograph company, Chas. A. Cheever, president; Felix Gottschalk; New Jersey Phonograph company, W. L. Smith, general manager; Montana Phonograph company, E. A. Benson; South Dakota Phonograph company, Henry Lacey; Pacific Phonograph company, West Coast Phonograph company, and Spokane Phonograph company, Louis Glass; Florida Phonograph company, Mr. Clarkson; Iowa Phonograph company, Whitfield Stinson, G. A. Beach, manager; E. P. Stone, treasurer; Nebraska Central Phonograph company and Nebraska Phonograph company, E. A. Benson; Colorado & Utah Phonograph company, S. W. Cantril, manager, John Barber, president; Illinois State Phonograph company, G. Farwell, W. H. Hubbard, Ed Lobdell; Wyoming Phonograph company, M. S. Lindsay, manager; Eastern Pennsylvania Phonograph company, Jas. O. Clephane, president; Western Pennsylvania Phonograph company, J. H. Friend, secretary; Columbia Phonograph company, Washington, E. D. Easton, president; R. F. Cromelin, secretary; W. H. Smith, treasurer.

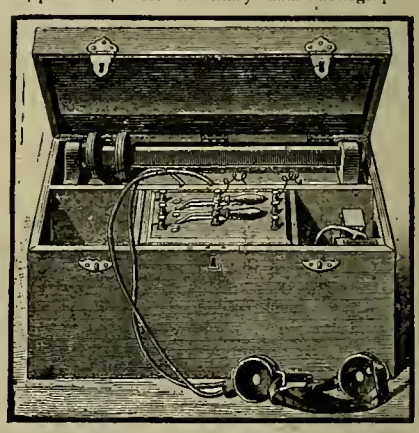


FIG. 3. DEVICE FOR LOCATING FLAWS IN SHELLS.

The following officers were elected:

President, W. Clancy.
Secretary, R. F. Cromelin.
Treasurer, H. D. Goodwin.
Reporters, W. H. Smith and H. D. Goodwin.

It has been stated that the phonograph men are enthusiastic. They believe that Bellamy has not begun to describe all the possibilities of the perfected phonograph. "The fact is," said one of the representatives at the convention, "we have made more progress than any great organization which ever had upon its hands so great a work. We are three years ahead of the telephone company when it had reached our present age. We think there is money in the phonograph. The company in which I am an officer is already paying dividends. There is an immense amount of work to be done but we believe the instrument will be so successful that we will be repaid for all the work required of us."

FIG. 1. DEVICE FOR LOCATING FLAWS IN SHELLS.

Portable Testing and Resistance Sets.

The accompanying cuts illustrate the new series of portable testing and resistance sets which are just being put upon the market by Queen & Co., Philadelphia. These sets were all designed to meet the requirements of electric light men, telephone line construction, dynamo and motor manufacture, and general testing. The set shown in Fig. 1 is the most complete of the series and is recommended for all kinds of work where considerable accuracy is required. The coils in this set are arranged in four rows, each row being made up of ten coils of the same denominations. The blocks in each row are numbered from left to right and from zero to ten, while the longitudinal bars underneath have engraved upon them the denomination of the coils of that row. The connections of the coils are such that but one plug is required for each denomination. By inserting a plug in any block as many coils of that denomination are thrown in as may be indicated by the particular number engraved upon the block. For instance, as the cut represents it, there are in circuit 369 ohms—i. e., no thousands, three hundreds, six tens and nine units. Another special feature of the set is the arrangement of the bridge arms which are seen at the left. These are combined with reversing bars so that the proportional arms may be instantly interchanged, an operation which is absolutely necessary in many special methods. An additional advantage is that but six coils are necessary in the bridges instead of eight, as usual, to get the proportion of 1 to 1,000 or 1,000 to 1, thus making the set smaller and more portable. The bridge coils are 1, 10 and 100 on one side, and 10, 100, and 1,000 on the other. To effect this reversal it is only necessary to change two plugs. The use of this reversing arrangement in testing sets is claimed as one original with Queen & Co.

The coils are wound of platinoid wire, which has a very high specific resistance, changing but .0023 for each degree centigrade of temperature variation. They are adjusted by Prof. Wm. A. Anthony to an accuracy of from 1-5 to 1-10 of 1 per cent. The bridge arms themselves are adjusted to a still higher degree of accuracy. The wire is of several hundred ohms' resistance and is wound so as to have a maximum effect upon the needle. The needle is an astatic one and is delicately suspended by a very fine cocoon fiber, so that there is practically no resistance to any deflecting force. By means of a very weak controlling magnet sliding upon the suspension tube the needle can be made almost perfectly astatic and will show an appreciable deflection for currents as small as from 1-3,000 to 1-5,000 of an ampere. The brass box containing the needle and coil is movable about a vertical axis, so that the former can always be brought to zero whatever the position of the box. The whole galvanometer lifts out of the case, and can be used independently if desired. Three screws are provided for leveling when so used. By closing the cover of the box the weight of the needle is automatically taken from the fiber and the latter protected from injury. The battery and galvanometer key are seen in the front of the box and are independent of each other. The whole is mounted in a polished mahogany box with leather handles and lock and key, and measures when complete but 18 inches long, by 6½ inches broad.

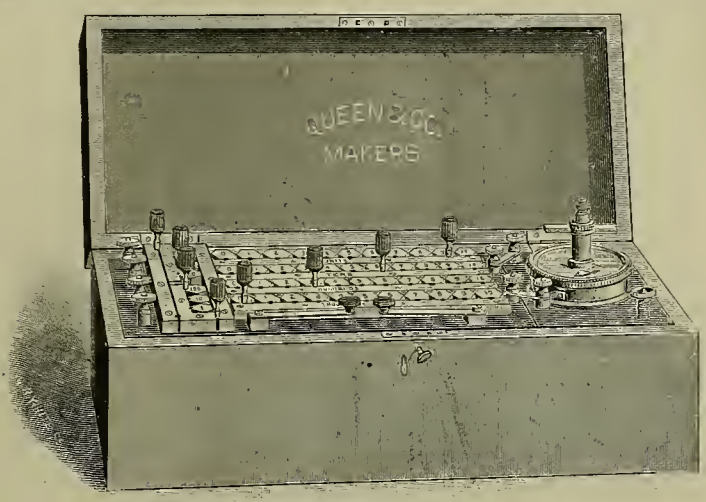
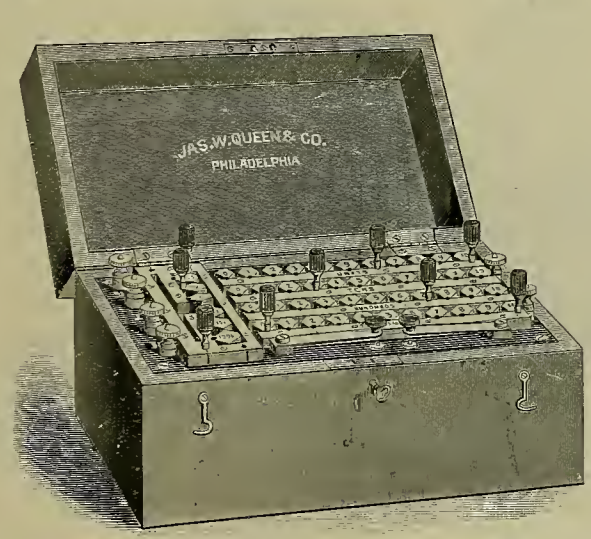
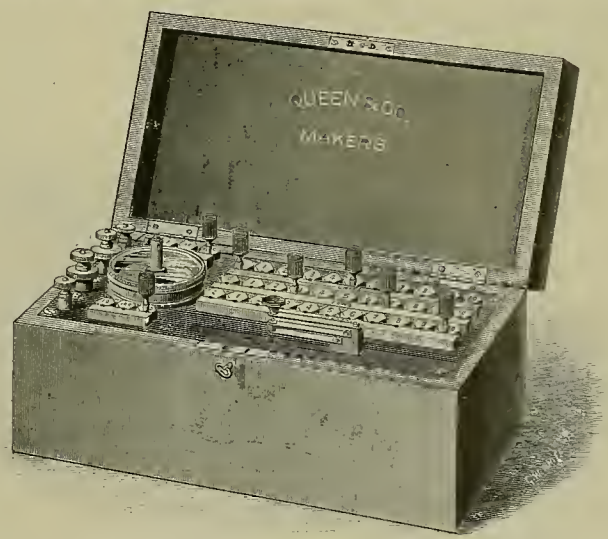


FIG. 1. PORTABLE TESTING AND RESISTANCE SETS.

Fig. 2 is a cut of the same instrument without the galvanometer. These sets have a ranged measurement from 1-1,000 to 10 megohms.

Fig. 3 shows one of the other sets of the series, which is of much the same general character. The coils are made of German silver instead of platinoid. They are not quite so accurately adjusted, and this set is without the reversing arrangement found in those just described. The galvanometer is also fiber-suspended but without the automatic release. For this purpose, however, a small set screw is used, which allows the needle to be lowered when not in use. The galvanometer is permanently mounted in the case and is without the control magnet. The keys are combined into the regular double contact form. This set has but three rows of resistances, viz., the units, tens and hundreds. It is made with an additional row of thousands, and is also made without the galvanometer.

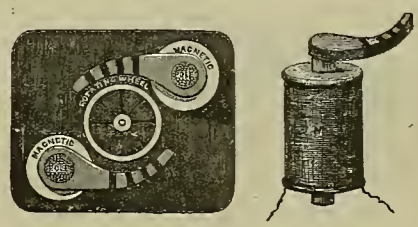




FIGS. 2 AND 3. PORTABLE TESTING AND RESISTANCE SETS.

The Wright-Ferranti Alternate-Current Meter.

The following is a description, from the London *Electrician*, of an ingenious form of alternate current meter which has recently been devised by Arthur Wright and S. Z. de Ferranti: The meter in its latest form consists of a pair of vertical electro-magnets, the magnets having divided iron cores. To the poles of these magnets are attached curved horns of divided iron which lie in a horizontal plane. These curved horns are magnetically throttled at intervals along their length with copper bands. The curved horns embrace a circular space in which can revolve a light copper or iron shallow cylinder of thin metal. This cylindrical band forms the periphery of a light wheel capable of rotation on a vertical axis. Geared to this axis is a counting mechanism. The axis also carries a vane having mica blades.



WRIGHT-FERRANTI ALTERNATE-CURRENT METER.

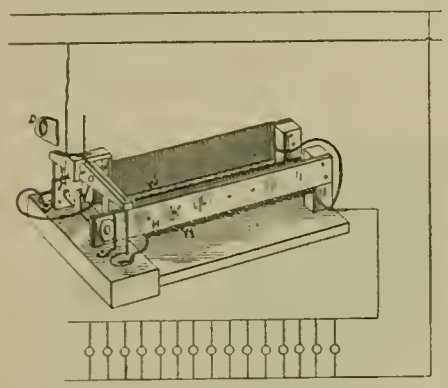
The principle may be thus briefly described: The throttling of the curved iron horns causes the rapidly reversed magnetism to take the form of a lateral diffusion of lines of force from the sides of the horns. In effect a series of oppositely named magnetic poles travels along the horn from the base, where it is in contact with the top of the electro-magnet, to the tip. These poles are represented by a series of bunches of lines of force, setting out laterally from the sides of the horn, and traveling up it. The lateral passage of these lines of force through the metal band which forms the rim of the movable wheel generates in it eddy currents. These are continually repelled by the moving field producing them, and hence a motion of rotation is given to the wheel by the alternating magnetism of the magnetic poles.

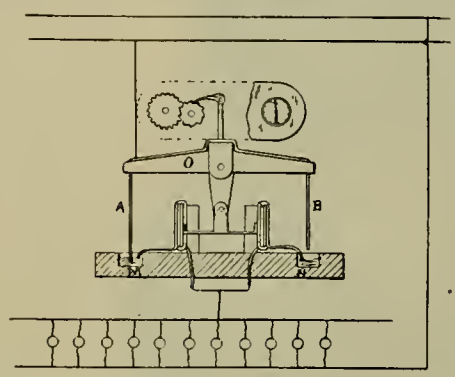
The speed of rotation, being retarded suitably by the vanes, can be made to be proportional to the current strength of the current exciting the magnets, and hence the total turns of the wheel in a given time to the total electric quantity flowing through the meter.

Method of Measuring Electric Currents.

In the accompanying cuts is presented a novel device for measuring electric currents, invented by E. W. Rice, Jr., of Lynn, Mass. The invention consists in alternately heating two expansible rods of solid material by the agency of an electric current flowing alternately in two branches of a circuit, automatically switching the current from one branch to the other by the movement of the expansible bars, as they alternately heat and cool, and registering the number of movements of expansion and contraction of the pieces.

The cuts are a diagrammatic representation of the apparatus. Fig. 1 shows its general arrangement in perspective, and Fig. 2 is an end view.





FIGS. 1 AND 2. METHOD OF MEASURING ELECTRIC CURRENTS.

In the diagrams *H* indicates an expansible rod made as a compound bar from two pieces of material, having different coefficients of expansion, so that when it is heated its free end will bend. *W* is an electric conductor forming the path of the current to be measured, and applied to the bar so that heat developed in the conductor by the passage of a current will be communicated to the bar. The movement of the bar *H* is imparted to an arm which, as indicated in Fig. 2, communicates movement to a register train. The movement of the bar *H*, sufficient to move the wheel one tooth, will correspond obviously to a given or determinate amount of flow of current in the circuit, including the conductor *W*. By causing a repetition of such movements, the amount of current consumed through an extended length of time may be registered or measured. For this purpose a switch *O* is employed in connection with the conductor *W*, so that it may be thrown alternately into and out of circuit. The switch *O* consists simply of two arms or contacts *A* and *B* joined to one terminal of the circuit and adapted to dip alternately into the mercury-cups *M N*. In the operation of measuring, the current flows first through conductor *W'*, for instance, and heats it. This heat is communicated to the same bar *H'*, and causes an expansion of the same. This movement of expansion is registered, as before shown. When the current has flowed a determinate length of time, the lever *O* is moved by the bar to such an extent that the circuit through the conductor *W'* is broken and that through conductor *W''* is closed. The current now flows in the conductor *W''* and heats the same. The heat thus developed is communicated to the bar *H*. This bar now expands in the well-known manner and communicates a movement to the lever *O*. This movement is also noted, or registered, and on its completion is followed by the reversal of the switch and a repetition of the operations described occurs, beginning with the heating of conductor *W'*.

Rice Automatic Tandem Compound Condensing Engine for Heavy Duty.

The Rice automatic tandem compound condensing engine as it is built for powers of 100 horse and under, is a familiar machine. The accompanying cut illustrates an engine of the same type, but modified to meet the demands of higher duties, for electric tramway and power plants, rolling mills and the like.

The view presented is of the back, and is preferred because it shows clearly not only the valve motion and the governor, but also the cylinders and frame. The low and unusually heavy frame will be noted; it is about 25 per cent. heavier than that of the standard engine.

With two exceptions, the frame and the governor, this heavy-duty Rice engine is practically identical in construction with the standard tandem compound engine already referred to. The crank disk being too small for the governing mechanism required on so large an engine, it has been found best to place the governor in the fly-wheel, or, in some cases, in a wheel of its own. The valve is then driven from a separate eccentric on the shaft; both valves being driven automatically by the governor. The valve itself is of the gridiron pattern, with four ports, and is so nicely balanced that it can easily be operated by hand when under full steam pressure.

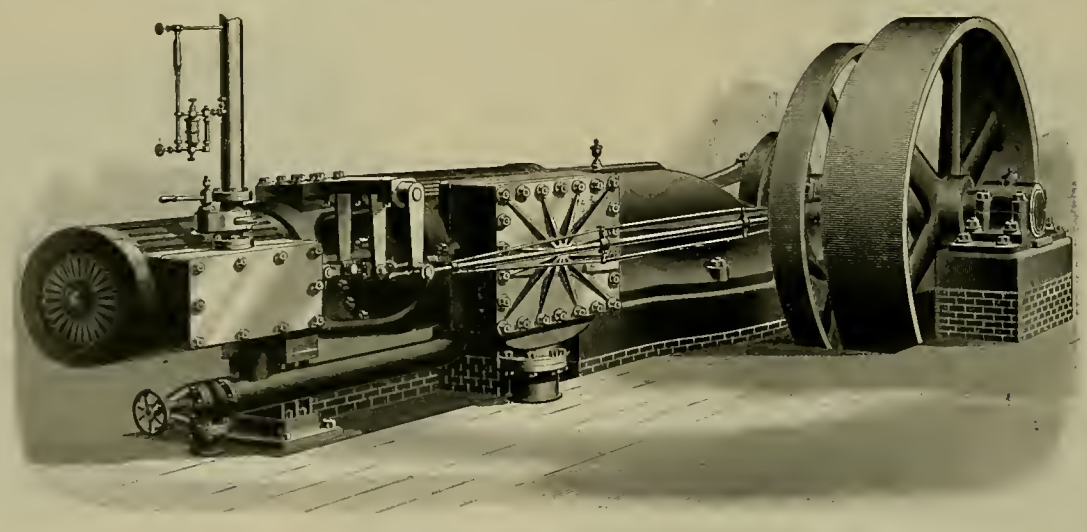
The main bearing is provided with quarter boxes, in order that the wear may be taken up in any or all directions. These boxes are lined with Babbitt metal.

The connecting rod is of forged steel, with a loop to contain the brasses for the crank-pin. This construction is more costly than that in the standard engine, but is warranted by the additional safety and strength which it gives.

The crosshead has a suitable take-up for wear, and is so arranged that it cannot be tightened to the point of cutting.

Engineers will particularly appreciate the fact that in this engine the low-pressure piston head can be removed without disconnecting the high-pressure, and of the arrangement by which steam may be used in either cylinder without employing the other.

The John T. Noye Manufacturing company, Buffalo, N. Y., is the builder of Rice engines. The western agents are Fairbanks, Morse & Co., Chicago.



RICE AUTOMATIC ENGINE.

Electric Lighting in Canton, China.

J. H. Ormerod, an Englishman, who claims to have been residing in China for some years, was in Chicago last week. He told an interesting story about the introduction of electric lighting in Canton: "Several months ago," he is quoted as saying, "a big syndicate controlling American and English capital started to put in an electric light plant in Canton. The news was heralded over all the world, and many Americans and Englishmen eagerly took stock in the venture. Not until after the necessary money and the franchises had been obtained did it appear that the scheme would be impracticable. The city of Canton is dead after 7 o'clock in the evening, and only those who have business to attend to are allowed to pass up and down the streets. There is no more need of lighting the streets of Canton at night than there would be of burning the lights here in the afternoon. Then, again, the streets are so narrow that it is with the greatest difficulty that the lines can be put up. But as the work was begun it was deemed best to continue it. A few weeks ago the big boiler came over from San Francisco, and it was carted toward the electric light establishment. When about half way to its destination it stuck fast in one of the narrow streets. And there it is now. It can't be moved either way, and a smaller boiler has been sent for. Why, the streets are so narrow that a New York alderman could not walk about the town. And it is in this place that they are trying to put up an electric light plant. It will be several years yet before the Chinese will read by electric light."

Mr. Ormerod's story is interesting, but there are good reasons to believe that he is misinformed, or at least that his statements are inaccurate, though he certainly should know something of the country in which he has been living. A year ago a distinguished Chinaman, a member of the imperial government, visited Chicago in company with a representative of the Chinese legation at Washington. Their mission was to investigate, and among the subjects of inquiry was the development of electrical science in this country. The visitor from the Orient was a practical electrician, and showed a familiarity with central station practice that could not have been obtained in a laboratory or schoolroom. He said there were a number of towns in China in which electric lighting was quite extensively adopted, and not a few of these boasted of street lighting systems. He declared that China was ahead of Japan in this respect, and that in a few years it would outrank

the European countries. The Washington representative of the Chinese government, Mr. Koo, who acted as interpreter, said that there were many cities at that time making arrangements to introduce electric lights for streets. From a report of the interview published in the WESTERN ELECTRICIAN May 4, 1889, the following is taken:

"Three years ago, when I left China," said Mr. Koo, "electricity had been used for street lighting, and they were introducing incandescent systems for business houses, residences and workshops. It is now quite extensively used in many districts. Peking, Hong Kong, Shanghai, Canton and other cities have a great many electric lights. I read in Chinese papers that electric lighting is becoming general in all the large cities, and is also gaining a foothold in the smaller places. Mr. Ku (the visitor from China) confirms these statements. I have no doubt that electric railways will soon be introduced into China, now that they have both railroads and electricity."

In this connection another circumstance may be recalled which tends to corroborate their report of the progress made in the empire. They spoke of the negotiations pending at that time between representatives of Chinese capitalists and a well-known American company for the introduction of the latter's system of lighting. Shortly after the announcement was made that this company had closed a contract to supply the apparatus for the central stations referred to, the statement was made that the machines were in readiness. Another item of interest that will be remembered by readers of daily papers is the fact that when the first machines were shipped at San Francisco, the "honest Chinamen" counted out in gold the amount due for the machines, and as the sum was quite large, the representatives of the American company, according to the press dispatches, were rather surprised at the proceeding, and did not relish carrying the gold about. This initial installation was followed by orders for additional machines, and a number of American experts accompanied the apparatus to China, and are there now superintending the work of installing it. It will, therefore, appear that the gentleman, whose statement is quoted from the daily papers, is misinformed as to his facts. There is no question that electric lighting has been successfully accomplished in China, and that there are in operation in that country to-day several commercially successful plants. This advancement is largely due to the energy and ingenuity of Americans, and this fact may have something to do with Mr. Ormerod's failure to see the plants, or, at least, appreciate their importance.

New Electric Railway Work.

The Brooklyn & Coney Island railroad, of which a view is shown in the accompanying illustration, has just been completed by the Thomson-Houston Electric company. This road consists of sixteen miles of track, which is equipped with center pole double bracket suspension, the trolley wire being suspended from poles placed between the tracks 125 feet apart, and provided with ornamental iron brackets.

NEW ELECTRIC RAILWAY WORK.

The car equipment consists of twelve double motor cars, and others will soon be added. The power station is provided with the necessary boilers for supplying steam to three 200-horse power engines, and the usual heaters, pumps, etc. The electrical apparatus consists of six 100-horse power Thomson-Houston railway generators of the four-pole type, and switch-board with the usual fittings. A part of the station is used as a car house, and is provided with eight tracks with pits underneath, thus rendering the cleaning and repair work an easy matter.

A view of the San Jose and Santa Clara railway, San Jose, Cal., is also given. This road is interesting, not only from its excellent construction, but that it is the first railway in California equipped by Thomson-Houston system. The road consists of nine miles of track on which the double overhead construction has been used, and will operate six double motor cars.

NEW ELECTRIC RAILWAY WORK.

Electric Club Organized at New London.

The interest in electrical investigation is increasing, as is attested by the formation of numerous electric clubs throughout the country. The latest candidate for favor is the Electric Club of New London, Conn., which was only recently organized. The officers are Ernest W. Bruch, president; James R. Troland, treasurer, and Clarence W. Ford, secretary. President Bruch says: "We have been doing good work lately, and expect to increase our membership rapidly, although it is rather small at present."

Electrical Execution.

It is now thought that the case of Kemmler will be fought over again on new grounds—the first point to be raised will be the unconstitutionality of the provision substituting the warden of the state prison for the sheriff as the executioner. This question will be argued before the General Term and then carried through the several stages, delaying the final decision as much as possible. The fight in the Supreme Court of the United States may not yet be abandoned. When Judge Wallace made his order staying proceedings in Kemmler's case, he did so on the understanding that counsel would immediately apply to the highest tribunal for a writ of habeas corpus, and thus obtain a final decision upon the constitutional objections raised against the proposed mode of execution. Judge Wallace announced that he granted the writ solely in order to save the prisoner's life until the constitutional points at issue could be decided by the Supreme court. This court declined to hear Mr. Sherman's application for a writ of habeas corpus for the reason that it could not regularly take notice of an original writ in such a case. Judge Wallace had made no decision on the writ, and therefore there could be no appeal upon which to allow the Supreme court to act in its appellate capacity. For the purpose, however, of securing a speedy determination of the question involved the Court directed Mr. Sherman to make application for a writ of error from the findings of the Court of Appeals of New York. The Court having decided the questions at issue against Kemmler, Judge Wallace, when his writ becomes returnable on the third Monday in June, will, of course, rule against Mr. Sherman on the matter of the habeas corpus writ. Counsel have the undoubted legal privilege of appealing from the decision of Judge Wallace next month, and, as the Supreme court has adjourned for the term, a hearing could not be had until next October. Whether or not, in view of the fact that the questions at issue have been settled and of the probability that the court would very severely censure the bringing of such an appeal for the sole purpose of delaying execution, counsel will still insist upon staving off the day of execution, is the question which remains to be determined.

Another name has been added to the list of condemned prisoners awaiting the result of the legal contest over Kemmler's case. Frank Fish, of Cacandaigua, was sentenced to be executed under the new law at Auburn, July 12.

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W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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REPRESENTATIVES of phonograph companies throughout the country held a conference in Chicago last week to discuss matters of interest relative to the instruments which they are putting on the market. The most interesting feature of the meeting was the reporting of the proceedings by phonograph, which is referred to in an article in another column in this issue.

THE Board of Public Works of Kansas City seems to be indefatigable in obtaining statistics. The board acts on the excellent principle of utilizing, as far as possible, the experience of other cities. A year or more ago it secured figures showing the cost of public lighting in a number of large cities throughout the country. This table has served its day and the secretary has been of late again engaged in securing figures showing the cost of lighting at the present time. Some of the statistics which he has obtained are given in the Kansas City letter.

HERMANN LEMP's paper on "Automatic Electric Welding Machines," which was read at the last general meeting of the American Institute of Electrical Engineers, is given in another column. Mr. Lemp treats his subject most exhaustively and the readers of the WESTERN ELECTRICIAN who are in possession of welding machines of the type referred to by Mr. Lemp will doubtless find the paper to be a most interesting one. We fear, though, to the majority of the readers the article will prove rather unsatisfactory owing to a lack of illustration. In view of the fact that this paper was written on a subject of such great interest to electricians and engineers in general, it is to be regretted that the author did not see fit to illustrate more thoroughly the many details referred to.

AMONG the many curious applications of electricity might be mentioned one which has lately been put in practice by a professor in the cavalry school at Paris. This gentleman has designed apparatus in which he utilizes the microphone in connection with a mechanical striker and a phonometer for detecting slight flaws in bombshells. The instrument which is called a "schiseophone" is described in another column. It is stated that a number of rails tested by means of the device were afterward broken and flaws were found to exist at points indicated by the apparatus. Such an instrument as this if proved thoroughly reliable would be undoubtedly most valuable in certain lines of work. For instance, in steam locomotive construction the parallel rods when finished, but before they are placed in position on the engine, are submitted to a most careful scrutiny to ascertain whether a flaw exists. This is only one case out of many where a reliable instrument of this kind might be of the greatest utility.

THE announcement has been made time and again that inventors were almost ready to give to the world the details of their schemes for economically producing electricity directly from heat. Time wears on, and these plans do not materialize. A new claimant for the honor of discovering inexpensive means of generating electricity directly by means of heat has been found by the daily press. According to the dispatches the inventor is H. B. Cox at present a resident of Hartford. His apparatus, which is not yet described, is so simple that he refrains from attaching to it the dignified name of machine. The dispatches state that "by Mr. Cox's method heat has been changed to electricity as simply as water is changed to steam. From glowing coals comes the subtle current, without the aid of boiler, engine, or dynamo." With the exceedingly meager reports that have thus far been published one has no basis for forming any conclusion whatsoever in regard to the alleged invention. Certainly no one would be warranted in denying the possibility of such an invention for the brightest minds in the electrical field confidently expect that this problem will be solved, ultimately, just as they anticipate the invention of a lamp which shall rival the glow of the fire fly, shedding light but emitting no heat. Still we think no one is looking for these inventions quite yet, and boiler makers, engine builders and dynamo manufacturers continue their work and give little thought to the possible invention of an iconoclastic machine which will enable the electrician to dispense with all their wares.

ELECTRIC lighting in China has formed the subject of many newspaper articles of late, and that country has been generally considered a promising field. Last week, however, an "English merchant from Canton" stopped in Chicago long enough to tell a reporter that the prevailing ideas were erroneous. This gentleman gave an interesting description of Canton, which must be a very sleepy place indeed, if correctly represented in the picture he presented. It is to be noticed, however, that the statements subsequently reported do not inspire implicit confidence in the Englishman's judgment, assuming, of course, that he is a gentleman of veracity. About a year ago there was a distinguished Chinese official in Chicago, and his report of the progress of electrical interests in the Orient was more highly colored than those made by American exploiters. He said that electric lights were then in use in Canton, and that they had been in operation in that city and elsewhere in the empire for three years at least. His familiarity with the operation of central stations supported his claims for he had not been in this country long enough to acquire knowledge of this kind. If further proof were needed it could be found in the records of large American electrical concerns which have found in the cities mentioned profitable fields. It may be that this substantial evidence which impressed the American manufacturers of electrical apparatus is not at the command of the English companies, but surely they must know that there are electric light stations in China, and that the remark that it will be long before the Chinese avail themselves of electricity, is absurd.

MENTION is made in the Pittsburg letter of this week, of the fact that the Allegheny County Light company has fitted up a photometer room as an accessory to its central station. This is somewhat of an innovation. Photometric work, as a rule, has been confined to the lamp manufacturer. The lighting company has rested content with the maker's guarantee of candle power. Now, however, that competition is rife, there is arising a gradually growing tendency toward a refinement of the old go-as-you-please methods. In this connection, too, it may be mentioned that the establishment of a photometric department by the Allegheny company brings to mind the form of contract which was recently recommended by an aldermanic committee on fuel and street lights of Holyoke, Mass.

Without again going over the details of this unique contract which was referred to in the Boston letter of May 10, we may say that the committee proposed among other things that the measurement of the lights should be made by comparison through the use of a Bunsen photometer. It was required, also, that the tests be made while the lamps were in their regular positions in the street. Such action as this seems clearly to indicate that consumers are awakening to a realization that arc lights may sometimes be fed with a current of 9 amperes when to develop full candle power they require 10. The consumer naturally wants to know whether value has been received. To say the least, then, his knowledge that the lighting company tests the lamp furnished would in itself be something of a guarantee of fair treatment. The action of the Allegheny company is to be commended, and the more far-sighted of our companies might do worse than to follow the example thus set.

IT is now intimated that the opponents of the electrical execution law have not discharged their last round of ammunition, and that a lively fight will occupy the attention of the New York courts during the warm summer months. The provision of the new law substituting the prison warden as executioner, in place of the sheriff of the county in which the crime was committed, will be the first question to be considered. The recent decision of the Supreme court settles all doubts as to the constitutionality of electrical execution as a penalty for murder. The expediency of the new method and its practical working is still questioned, not only by those engaged in electrical pursuits, but by many able and influential leaders in the Empire state, and every opportunity of assailing the obnoxious measure will be embraced. It is not at all improbable that some enterprising metropolitan journal may take a hand in the fight on its own responsibility. The *Sun* remarks: "The electrical execution law will come before the courts again after the first execution under it if the authorities attempt to enforce the prohibition against the publication of the details by newspapers; and then will arise a very interesting constitutional question as to the liberty of the press." This, it may be remarked, is the unanimous sentiment of the metropolitan dailies.

The question of substituting the electric current for the guillotine has recently been discussed in Paris. Among the authorities whose opinions have been solicited, there is a unanimity of sentiment against electrical execution that does them credit. It is of interest to note that they object to the substitution on the same grounds which led the legislators of New York state to make a change—by motives of humanity. The former think electrical execution barbarous and the latter think it the most civilized method of inflicting the death penalty. While we dislike to subscribe to a foreign judgment in preference to an American conclusion we must concede our belief in the correctness of the French opinion in reference to electric execution.

Automatic Electric Welding Machines.[1]

By Hermann Lemp.

Among the latest achievements in electrotechnics, stands prominently Prof. Thomson's electric welding process. The broad underlying principle has so often been described and exhibited by its able discoverer and others, that to repeat it again would be imposing upon your patience. The evolution of a new process and its reduction to practice for commercial purposes, especially if the leading elements of its working are novel in themselves, must necessarily open a vast field for investigation. Such is the case with electric welding and with a view of showing the commercial apparatus of to-day, it will be necessary for me to state the electrical and mechanical requirements which led to its construction.

The reason for which machines have been invented, has been for the purpose of reproducing faithfully and constantly a set of conditions necessary to obtain a certain result. When the conditions in any case are few and the product simple, generally one design of machine will be

Fig. 3

sufficient. With an increased number of conditions, however, the complexity of the apparatus increases rapidly and demands in many cases subdivision into different processes to be executed by separate machinery. What constitutes skill, in a working man for instance, is the ability to coordinately reproduce a number of operations or movements; to be, in other words, a perfect machine, or to produce the same result, even if other conditions than those previously contemplated should arise.

To secure uniform results in the practice of a difficult operation, there are two ways possible.

1. To employ skilled help for the complex portion of the work alone.

2. To substitute for the more complex portion of the operation, one more readily controlled.

The ordinary welding process requires the greatest skill at the hands of the blacksmith for heating the metals to the proper temperature and at the right spot, while preventing the accumulation of cinder or scale. While skill may be successful with metals of high melting points and low conductivity for heat, easily fusible metals and especially good conductors baffle all attempts as long as an exterior heating source is employed.

The electric welding process, has as you know, not only made it possible that operators not particularly skilled in the art of blacksmithing can produce good substantial welds, but has created an art equally adaptable to all metals and combinations of metals.

METALS.

The following are all the metals, alloys and combinations so far actually welded with success by the Thomson process: Wrought iron, cast copper, antimony, aluminum, manganese, cast iron, lead, cobalt, silver, magnesium, malleable iron, tin, nickel, platinum, wrought copper, zinc, bismuth, gold (pure).

ALLOYS.

Various grades of tool steel, various grades of mild steel, steel castings, chrome steel, musshet steel, stubs steel, crescent steel, Bessemer steel, cast brass, gun metal, brass composition, fuse metal, type metal, solder metal, German silver, aluminum alloyed with iron, aluminum brass, aluminum bronze, phosphor bronze, silicon bronze, coin silver, various grades of gold.

COMBINATIONS.

Copper to brass, copper to wrought iron, brass to German silver, brass to tin, gold to platinum, silver to platinum, copper to German silver, brass to mild steel, copper to gold, copper to silver, brass to wrought iron, brass to cast iron, tin to zinc, tin to brass, wrought iron to cast iron, wrought iron to cast steel, wrought iron to mild steel, wrought iron to tool steel, gold to German silver, gold to silver, wrought iron to mussbet steel, wrought iron to steel, wrought iron to crescent steel, wrought iron to cast brass, wrought iron to German silver, wrought iron to nickel, tin to lead.

But Prof. Thomson was not satisfied with this progress made above ordinary welding and early recognized the importance of a machine in which all conditions for successful operations are mechanically controlled to produce uniform results, by rapid working, and require little or no attendance.

Such machines, now known as automatic welding machines have proved to be of special importance in connection with easily fusible metals, enabling the successful welding of aluminum, silicon and aluminum bronze, which require even with the electric process a considerable skill.

Before entering into a detailed description of the automatic welder, a few general data on welding will be in order.

The Thomson process of electric welding can and has been worked by means of continuous or alternating currents; secondary batteries or unipolar machines may and have been used. There are such conditions as transportability absence of motive power, situation in continuous distribution district, etc., which may make it advisable to use the continuous current. The alternating currents have so far been the best adapted to be economically produced of large volume at low e. m. f. They are easily and economically controlled, can be distributed at high pressure with small conductors and it may be reduced to working pressure wherever needed. They have however, another beneficial effect, which is of importance in all welds of large sections.

It is a well-known fact amongst manufacturers of incandescent lamp filaments of large section that the inner portion in a filament is apt to be overheated. In treating filaments as used in the now commercial series lamp, in hydrocarbon atmosphere, the writer thought once to produce an extra good quality of carbon by starting with an extremely thin base .004 inch thick and obtaining a filament 90 to 95 per cent. of which consisted of hard, gray, lustrous carbon. He thought to extend this process to the manufacture of arc light carbons, and even produced pencils of about ¼ inch in diameter. What was his surprise, however, to find that although the lustrous surface presented at all times a dense gray structure, the core lost this character after a certain thickness of carbon had been deposited. In fact, a number of concentric layers would be discovered from the inmost graphite to the dense gray, semi-crystaline at the outside.

This action can in my mind only be attributed to the overheating of the carbon particles in the inside. A similar action takes place in a bar of iron if heated by an electric current. The surface exposed to radiation will be at a lower temperature than the core. It is true that the heating of the metal will increase its resistance and thus tend to equalize the temperature, but not enough in all cases. By the use of alternating currents we gain, however, an assistance in the self-induction. The effect of the latter is especially marked and has a tendency to concentrate the heat on the surface.

If there is any place which receives more current than another, the effect of the self-induction is emphasized by the fact that the surrounding part is cool and its permeability is greater than the part traversed by the surplus of current. With very large and especially wide metal pieces the unevenness of distribution may be remedied by approaching iron masses to create at a given spot a greater self induction or counter e. m. f., diverging thus the current from that section. Prof. Thomson has early recognized the importance of and patented a device to prevent the heating of the metal at a given spot by creating locally increased self-induction or magnetic effects.

In view of this, an experiment almost daily witnessed by us, it is interesting to note the paper controversy between parties disputing the priority of a device which is to produce exactly the opposite result with, however, the same means and conditions.

Two methods of distribution are in use, the direct and the indirect. In the former an alternating current dynamo is used, having two windings on the armature, one of which furnishes currents rendered continuous by a commutator to excite the field magnets and is controlled by switch and rheostat; the other consisting of a single turn of heavy copper cable furnishes the welding currents, which is led through collector and brushes to movable copper clamps suitable to receive and guide the welding specimens during the operation.

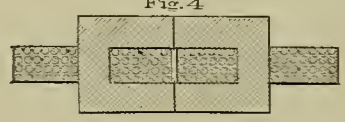
In some other forms, the field magnet is the movable part in which case no heavy currents have to be carried through collector and brushes. No direct welders are built at present for currents larger than 4,000 amperes.

The indirect method of distribution is almost exclusively used to-day. It consists, in its simplest form, of one alternating current dynamo, self or separately excited, and one welder which is a transformer with the necessary clamping and operating appliances. The self-exciting dynamos used are from 1,000 to 20,000 watts output and may be regulated by means of a reactive coil to give a varying e. m. f. never to exceed 300 volts.

They are substantially built to withstand sudden strains, have self-oiling bearings, brushes are never to be moved and are perfectly sparkless, requiring no other attention except cleaning.

The winding on the transformer being once for all set, variation in the e. m. f. has to be obtained either by varying by hand the initial e. m. f. of dynamo or to excite a dynamo to the lowest potential required, it being so compounded as to give with the maximum work the increased e. m. f., or finally to maintain a constant e. m. f. at dynamo

Fig. 4



under all loads and vary the e. m. f. at the transformer by interposing a variable resistance or preferably self-induction. The transformer itself may be built so as to give a different ratio of conversion, either by moving the primary and secondary relatively to each other or by shunting lines of force by means of an iron bridge between primary and secondary, or by altering the number of turns in primary or secondary by a switch.

When a single plant is used, viz., one dynamo and one welder, it is the dynamo generally which, if separately excited, is regulated by means of a rheostat in the exciter circuit or by a reactive coil in series with exciting coil on the the armature if self-excited. Diagram No. 1 shows the connections used with a separately excited machine. The only thing different from similar installations is the break switch which is operated by a foot treadle, and automatically opens the circuit when foot pressure is removed.

This prevents any mishaps when operated by uninitiated persons, as all action ceases when one leaves the apparatus. The primary voltage never exceeds 300 volts with 100 alternations or 50 complete cycles per second. Nothing but the very best insulation is used in the primary wiring. It is deemed necessary to protect the customers not only against any shocks, but even against the scare of one, and we recommend the permanent grounding of the secondary which in welding apparatus constitutes virtually the table and pressure devices.

Diagram No. 2 shows the connections used for a self-excited composite dynamo, which has two windings on the armature, a longer main and shorter exciting coil. Both are wound in the same direction and currents generated therein pass in multiple commuted through the shunted field magnet, thence through line No 2, controlled by a break switch and split, one returning through reactive coil and line 3, the other through welder and line 1 to their respective windings. The exciting effects of each circuit add themselves. The reactive coil is conveniently placed near the welder. The dynamo is regulated from minimum to 300 volts and excited for each weld anew.

For some work which must be done at great speed, the second method is resorted to, that is, to keep the field constantly excited by fixing a variable reactive coil in a given position just enough to produce about 150 volts, the lowest e. m. f. required. The proportion of the field magnets, the e. m. f. of the exciting coil and the resistance of a shunt to the field are such as to produce an overcompounding of 100 per cent. in this case with largest current in the primary.

This method of regulation is very nice as it is absolutely automatic, responds quickly, the field of the dynamo not requiring to "build" every time from residual magnetism alone. We sometimes call it "cubic compounding," as it produces a constant heating effect for variable cross-sections and variable lengths as well. With this modification the wiring of diagram No. 4 is slightly altered, the break

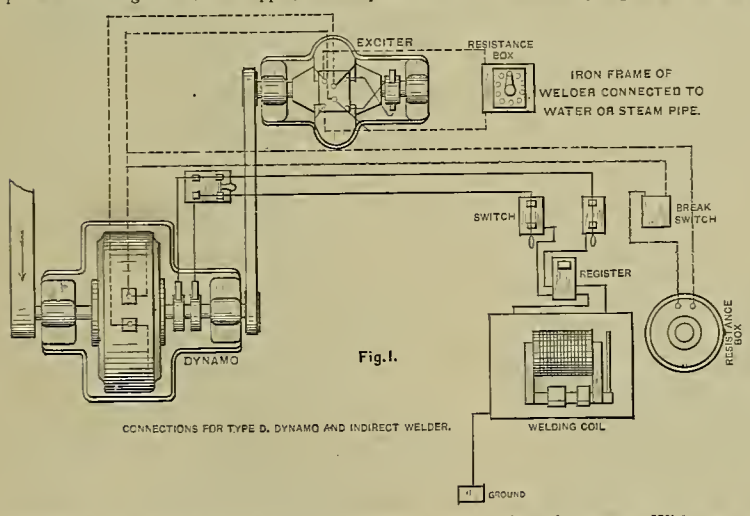
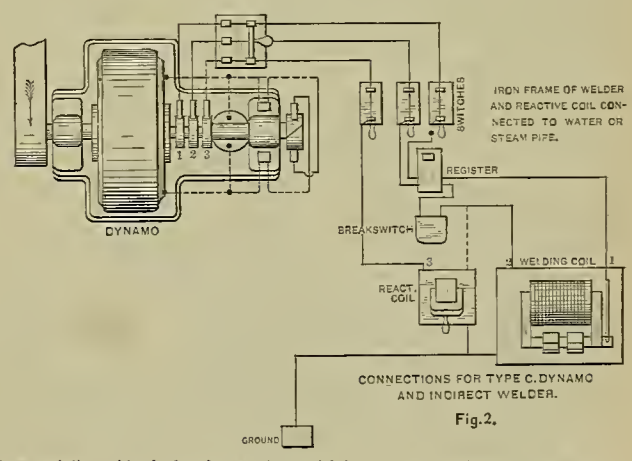


Fig. 1.

CONNECTIONS FOR TYPE D. DYNAMO AND INDIRECT WELDER.



CONNECTIONS FOR TYPE C. DYNAMO AND INDIRECT WELDER.

Fig. 2.

[1] Read before the general meeting of the American Institute of Electrical Engineers. Boston, May 21, 1890.

switch breaking only the main circuit, leaving the exciting circuit permanently closed.

The methods so far described are only used when a single welding machine is to be operated. It was early recognized that if the process is at all to be used on a commercial basis that at least the generating of the necessary currents should be limited to as few machines as possible. It required, in other words, a dynamo giving a nearly constant e. m. f. of sufficient capacity to feed a number of welders while maintaining for each absolute independence.

Since all welding for a long while to come will probably be operated in isolated plants, the dynamo is to be placed in the hands of an engineer generally, not an expert in electrical matters, and has, therefore, to be easily attended and free from all the little faults and kinks which are at present the sole consolation of the dynamo tender. One of its prime requirements is close automatic regulation under all loads.

Constant potential, self-regulating dynamos are manufactured in various sizes and are self-exciting up to 30,000 watts output Dynamos with large output are separately excited, but also self-regulating. The methods employed to obtain regulations are novel and will form the subject of another paper at some future date.

I would simply state that either constant potential or a per cent. increase with load can be obtained and that the

Fig. 5

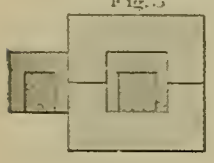
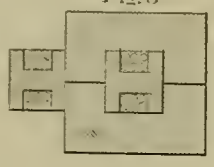


Fig. 6



regulation will respond even if the load consist of self-inductive translating devices.

I lay some stress on the regulation of the dynamo for the reason that the generators are not to be placed in the care of special attendants as in the case of a central station, but have to deliver their currents under constant pressure whatever may be the conditions of work they are subjected to; even an automatic regulator would hardly be able to follow the rapid variation of load.

The following conditions influence the perfection of the work and are variable with different materials and sizes:

1. Projection of the abutted pieces in the path of the current.
2. E. m. f. of welding current as controlling the strength of current flowing.
3. End pressure applied to force the abutting ends into each other at welding heat.
4. Interruption of current at proper time.

1. The projection of the abutted pieces varies with the diameter. It has been found that for copper, a projection of two times the diameter for each clamp gives the most economical results. With steel and iron, the most economical projection equals the diameter, and is for brass one and one-half times the latter

The projections sensibly effect the energy required and the most economical one depends upon the heat-conducting properties and specific resistance of the specimens. Accordingly high conducting bodies require longer projections, highly resistant ones short projections. Conductors of larger and smaller diameters may be welded by giving to each its respective projection. In the same manner may wires of different materials be joined to each other.

It is easily understood that since unequal projections on different sized conductors produce the proper heating of both at their junction, equal projection of equal sized conductors will be required. All other conditions neglected, it is important to keep the projection for a given size and material constant.

2. The e. m. f. required depends upon the projection and the resistance of the material to be welded. For larger cross-section, the specific self-induction plays an important role, and indirectly the shape of the specimen.

Another factor affecting the e. m. f. is the resistance between clamps and material and the resistance of copper

Fig. 7

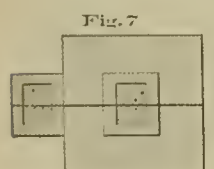
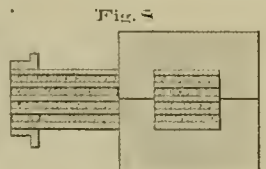


Fig. 8



conductors. The e. m f. required for iron and steel is nearly double that for copper and would be four times if equal projection were used for both.

A certain drop of e. m f. will be found from the clamps to the specimens. This drop is rather low on materials having naturally bright surfaces, as for instance copper, brass, german silver, tin or even cold rolled iron and steel. For a large class of work, however, especially in carriage hardware, the surfaces to be used for contact have a light scale left after passing through the rolls, which has either to be removed by grinding or filing or to be overcome by the e. m. f. of the current. In a good many cases, the introduction of a special process of cleaning is deemed to be more expensive than to use a little extra power to work through the scale.

3. For uniformity of result the end pressure required to press the abutting specimens into each other at welding heat is of more importance than any of the former agencies; this is, in fact, the one which controls and rectifies any inaccuracies in the former conditions. If the pressure necessary for a given size and material is used, the weld cannot be performed until the metal has acquired the necessary plasticity to yield to the pressure. If, for one reason or another, the e. m. f. and, consequently, the current should have been too strong, the time necessary for welding alone is affected, and in this case shortened. The bars will, however, be united at the same temperature and with the same force, whatever the time may have been used to bring about the plasticity necessary. The pressure will in some respects influence the heat by forcing the bars into each other at either higher or lower temperature, and by so doing cause the action to be interrupted at an earlier or later period, as may be required.

The pressure required varies with the material and is approximately 1,800 lb., per square inch for steel; 1,200 lbs. per square inch of iron; 600 lbs. per square inch of copper; it varies also with the area of cross section as indicated by its being expressed a function with the surface as one of the factors.

4. The interruption of the current as soon as the weld is completed is important for all easily fusible metals. When two copper wires are welded together the welded portion being increased in cross-section owing to the end pressure, if the current is not interrupted a large portion of the conductor on either side of the weld, including the latter, become heated and will melt and be torn asunder before any pressure device could follow and bridge over the gap.

The current should, therefore, be interrupted as soon as the weld is completed It is also sometimes required that the parts to be welded should be of a certain predetermined length, in which case the interruption of the current as soon as the allowable distance has been reached is essential.

All these conditions are maintained constant in the automatic welder before us, which is the first commercial type of its kind. This welder is not entirely automatic in the strict sense of the word. The degree of automatic action has to be considered for each individual object separately. This machine contains however, the leading features as covered by Professor Thomson's patent, June 26, 1888, No. 385 022, with a few improvements in mechanical construction. The capacity of the machine is nominally copper wire No 6 to No. 17 A. G. It will, however, weld larger and smaller sizes. It weighs 130 pounds complete; the secondary is one solid copper casting of a cross-section resembling a hollow, square box with one of the sides removed.

This casting is firmly screwed to an iron table. A saw cut at right angles to the plane of loop creates the two poles one insulated from the table, the other constituting a V-shaped bearing suitable to receive a sliding clamping device

The hollow part of the secondary is to receive the primary coil which is separately wound in a form and insulated with special care. Two U-shaped laminated iron cores embrace the primary and secondary.

It has been found that the best form of the transformer is the one in which the primary and secondary coils are coaxially placed in an iron core, so as to cause all lines of force generated by the former to cut through the latter. If the two windings are placed side by side on an iron core, or on opposite legs, as shown in sketch Fig. 3. there is a tendency to form consequent poles at the point where the two windings meet, due to the leakage of lines of force. The leakage will depend upon the distance between the two legs, and upon the length of magnetic circuit. It has been purposely increased and turned to advantage by Prof. Thomson, for obtaining constant current in the secondary, while the primary is supplied with constant e. m. f., Fig. 4. When, however, constant e. m. f. in secondary is required, it is important that this leakage should be decreased to a minimum.

Various forms of secondary may be employed to work consistent with the above principle. A few of these are shown in the diagrams, Figs. 5, 6, 7 and 8. In these cases the secondary is preferably a solid copper casting. The forms shown in Figs. 8 and 9, however, permit hard rolled copper plates to be used.

For mechanical reasons and convenience the forms shown in Figs. 5 and 6 are mostly used, and actual experience shows practically no leakage This construction permits of removing the primary without disturbing the secondary in the least. It also gives the least possible self-induction for a given cross-section.

It is often found stated that when large quantities of alternating currents have to be conveyed through copper conductors, it is important to have the same laminated or subdivided in smaller conductors to reduce self-induction. This may be true to a certain extent. The shape of cross-section is, however, far more important than the lamination.

An experimental compound conductor, consisting of a number of flat copper ribbons in parallel, showed a self-induction of *three* when the ribbons were closely packed, of *two* when separated into two parts, and *one* when spread open like a fan.

The explanation for this was given to the institute last year by Prof. Thomson, when he showed self-induction to depend mostly upon the length of the lines of force surrounding a conductor when traversed by intermittent or alternating currents.

Returning to the subject before us, we find that the pole which is insulated from the table constitutes the stationary clamp. The uninsulated pole, which is considerably larger, has on its upper side a long V-shaped groove parallel with the axis of the secondary, Fig. 10. A movable copper block, also V-shaped, fits in the bearing and can be slid in the same forward and backward.

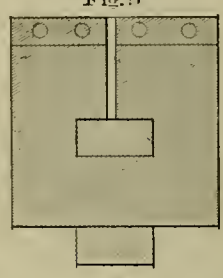
This movable block carries the second clamp The current necessary for welding has to pass through this sliding contact. The welding of small copper wire, or any other easily fusible metal, is a very difficult thing if special apparatus is not used. The current required is very large, several hundred amperes for wire not larger than No. 17 A. G.

The metal, when it reaches welding heat, readily melts away, and has to be followed by the movable clamp, so as to prevent the breaking of the circuit. This latter action when it occurs is so violent that a special device is necessary to prevent injury to the coil in case of such a rupture. The movable clamp, in order to follow the softening of the metal, has, therefore, to have as little friction as possible, and yet has to make a good contact to carry the heavy currents. The clamp is furthermore required to move in true guides, so as to abut the small conductors with their axes in line. The heating necessarily brought about when rapid and continuous welding is done must not interfere with the bearing and cause the carriage to stick through expansion.

All these conditions have been complied with in using the V-bearings, the carriage being held down in contact by means of a heavy spring and a number of copper rollers being interposed between the carriage and the bearing, Fig 10. The copper rollers are simple short pieces of ¼-inch hard rolled copper wire, rounded at the ends There are sixteen altogether, eight toward the front and eight toward the back of carriage, equally distributed on both sides of the bearing.

A stationary rod at apex of the bearing prevents the interference of the two rows of rollers. Between the two sets of rollers in front and in back, a bolt passes, applying the spring pressure, forcing the carriage into contact with the bearing. A pressure of forty pounds may be employed, and

Fig. 9



yet the carriage will move freely. These sixteen rollers have to transmit a current of approximately 3,000 amperes. They absorb about 20 per cent. of the total energy, which loss is, however, fully balanced by the reliability and simplicity of the device This loss is, moreover, only on the maximum sizes, and becomes insignificant on small work.

An adjustable coiled spring pulls the sliding clamp toward the stationary one. In front and pivoted on a lever is the distance gauge, which may be inserted between the two clamps. This gauge carries on a central disk a number of steel pins of varying lengths, but equal of projection on either side of the disk. These projections, if inserted between the two clamps, give the necessary distance required for a given size of wire, the disk against which the wires are abutted insuring equal projection of both ends to be joined. On the back of the apparatus a switch is located in the primary circuit, which is normally held open by a spring. By moving the handle to the right the primary will be closed and the switch locked by a little catch underneath the table. A pin fastened to a movable clamp will lift the catch and release the switch, thus opening the circuit.

An intermediate lever between catch and pin, operated by a sliding rule, which serves also as an index, permits of varying the point of cut-off, which has to be in a certain relation to the distance between clamps. The position of

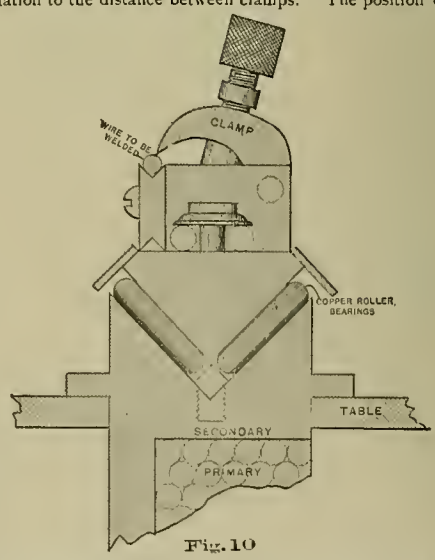


Fig. 10

cut-off tension of spring, distance between clamps corresponding to each other are marked with the same figure, which is also inscribed on a wire gauge fastened to the welder. By inserting a wire into the gauge the number read will give the necessary adjustments at once.

If by imprudence the switch should be moved to the right while no stock is inserted, and the clamps in contact with each other, the switch cannot be locked, and the fuse in the primary will be blown without, however, causing any damage.

The insertion of the distance gauge between clamps locks the switch so that primary can only be closed after withdrawing the gauge.

The operation is as follows: 1st. The wires to be welded are gauged. 2d. The distance gauge and cut-off are set to correspond with the number on the gauge. 3d. The movable clamp is moved to the right and gauge inserted. 4th. Both wires are securely clamped, care being taken to abut the ends squarely against the disk. 5th. The gauge is

withdrawn 6th. The switch is moved to the right 7th. The reactive coil moved toward a position of minimum reaction, and restored to maximum after weld has been completed. 8th. The clamps are opened and the weld removed, after which the operation can be repeated again.

If a good many welds of the same sized material are to be made, the reactive coil may once for all be set in a given position, and the switch alone be operated.

Welds made with the automatic machine have attained a uniformity not obtainable with very skilled operators working without it. In fact, small, easily fusible wires can scarcely be welded with certainty with ordinary apparatus. For aluminum especially, the automatic apparatus is needed.

The reactive device used in connection with welders is the type recently described by Prof. Thomson, in which a cast is made to more or less cover the primary, the self-induction of which is to be altered. To obtain still a large range, the windings of primary can be coupled in series or multiple series, or multiple by a switch in the base of the coil.

As mentioned before, the welding of easily fusible metals may sometimes cause a rupture of the secondary circuit, which, owing to its violence and volume of energy, may cause a burn-out of the primary if not guarded against. This danger is not very great in the automatic machine, since the end pressure does not depend upon the attention of the operator. A special device is, however, used as an extra precaution against all emergencies.

Breaking a high tension circuit rapidly is not easily done. An arc generally follows the break, and this lengthens the time of the rupture. If the voltage of the circuit to be broken is so low that over the slightest distance an arc cannot follow, the break will be instantaneous. This is the case with the secondary circuit of the welding transformer. The voltage being ordinarily only one volt would, even if increased ten fold, not be able to maintain an arc. However, multiplied in the primary it will cause e. m. f. sufficient to pierce through the insulation as ordinarily used. This action is similar to a Ruhmkorff coil in which the interrupter is caused to break under oil or water.

This discharge is taken care of by a special apparatus, the description of which I reserve also for another communication to the institute

While the machine before us is only one type embodying the principal features contained in all, others have been manufactured, or are in process of construction, in which the automatic character has been carried out even farther, as in the welding of rings and chains. I am not permitted to give a detailed account of these latter at the present time, but would say that the present model in its first form is able to produce 250 feet of chain in a day without any attendance to speak of, the plain wire being fed into the machine at one end and the complete chain coming out at the other.

The automatic principle is, however, not confined to small conductors. We have welders with 40,000 watts output, capable of welding 1 inch copper or 2-inch iron, constructed and working daily on that plan. The projections are determined by adjustable stops, the pressure, the most important of all, is hydraulic, and regulated by an automatic reducing valve, the exhaust being used for cooling clamps at the same time. The primary is controlled by adjustable reactive coils from a constant potential circuit, and is interrupted at the proper time by the clamps While not all machines to-day are operated on this plan, I am convinced that the evolution of the welding process tends in that direction, and that the welding in future will be in the full sense of the word a purely mechanical operation. This cherished idea of Prof Thomson's, uttered a few years ago, has well been borne out by the experience gained in actual operation on a commercial basis.

The city council of Racine, Wis., recently adopted an ordinance regulating the placing and maintaining of poles, wires and all other appliances for the transmission of electrical energy, and making rules and providing all the details of inside as well as outside wiring. At their last session the council unanimously elected Prof. R. C. Hindley as city electrician, to act under the ordinance.

The Beck Twin Compound Engine.

The cuts presented herewith illustrate a new compound engine which has recently been designed by the Taylor Manufacturing company of Chambersburg, Pa.

Instead of placing the cylinders one in front of the other, as in the style known as the "tandem," they are placed in this engine side by side with the common wall between, hence the name "twin." Each cylinder has its own piston, and both are attached to one common cross head which in turn is connected by one single connecting rod to the crank pin.

The valve chambers are also placed side by side beneath the cylinders, with a chamber between them into which the exhaust steam from the high pressure cylinder is discharged through the port or opening between the valve chambers, as shown in Fig. 1. A cap or bonnet, removed in the cut, serves as a connection between the end of the valve chamber of the high pressure cylinder and the port of the receiving chamber. Each end of the chamber is fitted with a bonnet, thus making a very short distance for the steam to pass from the ports of the high pressure cylinder to the chamber. From the chamber it passes to the valve chamber of the low pressure cylinder, and thence into the cylinder proper where it exerts the expansive power still remaining after having done its work in the high pressure cylinder. The wall or side of the exhaust receiving chamber next to the valve chamber of the high pressure cylinder is exposed to the live steam from the boiler before it enters the high pressure cylinder. This arrangement helps to prevent loss of heat from the exhaust steam in the chamber. Still further protection is afforded the exhaust steam by passing it through the hollow piston valve of the high pressure cylinder, which is surrounded by live steam from the boiler preparatory to being distributed into the high pressure cylinder. The exhaust chamber is also of such proportion as to receive the steam without back pressure and prevents unnecessary expansion of the steam before entering the low pressure cylinder, the importance of which is readily understood by engineers.

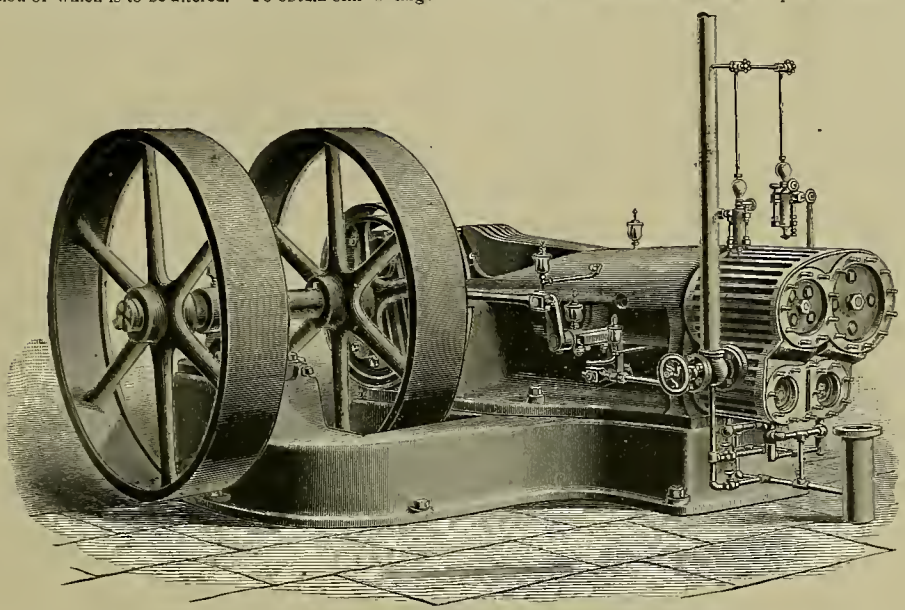


FIG. 1. BECK TWIN COMPOUND ENGINE.

The pistons used in this engine are fitted with steam packing; the valves are of the hollow piston type, provided with L shaped packing rings that are adjusted by steam. The valves of the two cylinders are operated by one eccentric which is the same as used on the plain engines. It may be mentioned also that the plain style of single cylinder engine made by the same firm can be changed to a compound by simply putting on new cylinder, cross head and rocker arm to connect with the valve stems.

The manufacturers guarantee as economical performance of the engine in regular service as was obtained in tests made at the shops, and which are detailed below. The conditions of test were not made with special arrangements, but by using simply a common return tubular boiler, with good draft and with plain setting, good bituminous coal from the Cumberland regions, feed water heated to 208 degrees, all live steam pipe covered, and cylinders of engine not steam-jacketed. The engine tested had an 8 in. diameter high pressure cylinder and a 13½ in. diameter low pressure cylinder with 15 in. stroke. The tests were made with a friction brake. During a continuous run of 15 hours the engine worked at an average maximum load of 90-horse power on a little less than 2 pounds of coal, and 24 pounds of water per horse power per hour, with boiler pressure of 100 pounds. During another continuous 15 hour run, 40-horse power was developed with 2½ pounds of coal and 27 pounds of water per horse power per hour, with 100 pounds boiler pressure. During a continuous run of 11 hours the engine developed 25-horse power on 3 pounds of coal and 35 pounds of water per horse power per hour, with 100 pounds boiler pressure.

Electric Lights in the Columbia Theater, Chicago.

The new management of the Columbia theater, Chicago, on taking possession of the house, decided upon making many radical changes, one of them being the system of lighting. This theater was the pioneer in isolated plants in Chicago, and one of the first in the country to adopt electric lighting. An Edison plant of 1,000 lights was installed. It gave excellent results, and added greatly to the attractiveness of the theater. It has been decided, however, to take out the machines which are of the old type,

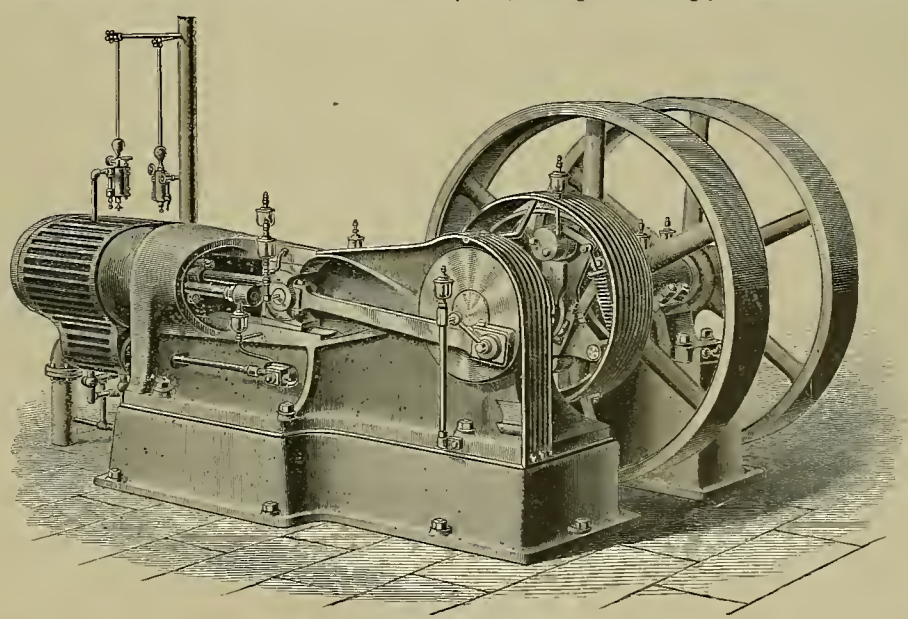


FIG. 2. BECK TWIN COMPOUND ENGINE.

and hereafter secure current from the Edison central station on Adams street. It was also deemed advisable to rewire the house and change the system of distribution. The Chicago Edison company secured the contract, and during the last week, while the theater was closed, a large force of men were employed wiring the house. When the theater was opened, the home was brilliantly illuminated throughout. A thousand incandescent lamps were distributed throughout the house, and everything worked entirely satisfactorily. The management also decided to install four electric motors to operate ventilating fans and a pump. The contract was awarded the Detroit Motor company for one 2-horse power, one 10-horse power and two 5-horse power motors. During the summer season, therefore, the patrons of the house will have no occasion to complain of heat.

One advantage from the new system of lighting will be the absence of noise from the machinery. The new plan will also prove economical, it is thought, as a few lamps required during the day will not cost nearly as much as the expense of operating a dynamo.

Magnetic Boiler Cleaners.[1]

By William B. Bull.

Some weeks ago I was requested by our secretary to present a paper to this convention on the subject of cleaning boilers by electricity; by means of magnetism it should have been stated as electricity may or may not be a direct factor in the operation.

Those of you who were present at the convention at Louisville may recall some statements there made by me, descriptive of a device which I had gotten up for use on my own boilers, and which had done good work for quite a period. It consisted, you may remember, of an electric magnet attached to the mud drum of a boiler, another electro-magnet attached to the steam drum, and an iron yoke connecting the two magnets which were excited or made active by a current of electricity generated by a small dynamo, which in its turn was operated by a small Tuerk motor.

Some one asked what my theory was concerning the operation of this device and I said that the best theory I had been able to devise was that the operation was a mechanical one, the result of rapid polarization and depolarization of the boiler by means of an interrupted or alternating current, setting up something like a vibration in the shell and tubes, which prevented a lodgment of scales upon their surfaces, the mineral being kept as it were dancing like a grain of sand upon a drum head. I stated also that an eminent electrician had concurred with me in this view of the matter. The month after the convention, however, I stumbled upon a paragraph in a newspaper giving an account of some chemical changes which had been observed to occur in the field of a magnet by a Californian named Frazer, and which he had turned to account by inventing a machine for ageing wines and spirituous liquors, that is to say, he produced in wines, etc, by the action of powerful electro-magnets, those changes which had heretofore only been attained by age or patient waiting His method was to place the wine in tanks which were surrounded by great coils of insulated wire; he then passed a current of electricity over his coils of wire, and this established a strong magnetic field in the space which they included, and which was occupied by the wine, the effect upon the wine being distinctly noticeable.

Here was a decided suggestion that the operation of magnets upon steam boilers was not a mechanical but a chemical one, and that it was the water in the boiler and not the boiler itself which was affected. I accordingly constructed a simple device, consisting principally of a tubular or hollow electro-magnet, operated by a dynamo as heretofore, through which the feed water was made to pass on its way from the feed pump to the boiler. Fortunately I was able to attach this apparatus to a new boiler, and after nearly a year of use it has been pronounced by the inspector on his subequent and recent inspection as being entirely free from scale, both shell and tubes. This is one of my own boilers and part of a battery which has given more or less trouble from scale until I began employing magnetism as a preventive.

A wish to still further simplify this machine and to render it perfectly automatic and independent of attention on the part of the engineer, led me to experiment in the direction of substituting permanent steel bar magnets as a source of magnetic energy in place of the more complicated dynamo and the electro-magnet, so that as I now prefer to construct the machine, it consists of an iron cylinder ten inches in diameter or less, dependent upon the service it is to render, and about twelve inches long. This cylinder is strong enough to resist all reasonable pressure; has flanged heads and is set on the feed pipe, preferably before the feed water enters the heater, if there is one, as a current of hot water flowing over the magnets which are kept in position by the cylinder, is weakening to them. Water of the temperature of 100 degrees or less does not impair the strength of the magnet, which, if treated in accordance with a few easily met conditions, may be considered as substantially indestructible.

The life of a compass needle may be cited as a type of their probable durability. The magnets are arranged within the cylinder just referred to, in sheaves or bundles; they are made of straight bars of hard steel, not horseshoe in shape; are somewhat separated to allow of their proper relation to each other and to permit an uninterrupted passage of the feed water. In a cylinder of the size referred to 10 inches in diameter, there are about 150 magnets made of ¼ steel one inch in width and of varying lengths, from 3 to 10 inches

The apparent effect of the process—that is to say, of passing the feed water through an intense magnetic field thus produced—is to change the relation previously existing between the water and the mineral impurities held by it in solution, so as to destroy their scale producing properties, and the mineral impurities seem to be thrown down to the bottom of the boiler in what I call "slush." An excellent opportunity for a test presented itself in the shape of a boiler in use in a lime burning establishment near Quincy, Ill. The boiler in question was fed from a well at the edge of a limestone quarry, the water being perfectly clear and to the eye free from organic matter and all visible impurities, but under the usual well-known tests showing excessive hardness even for well water in a limestone region. It was in fact so bad that the tubes in this particular boiler are renewed twice a year as a rule on account of the scale which forms on them.

The proprietor of this boiler told me that in cleaning it every fortnight he usually found some loose scale in the bottom, which unequal expansion and contraction had detached, and a small quantity, less than a handful, of what looked like sand. After the use of the magnets for ten days, a heaping shovelful of this sand or disintegrated scale was taken out, and after two more weeks not less than three shovelsful of the same was removed, mixed with fragments of friable scale; this was at the last cleaning about ten days ago. The boiler, I ought to say, was a small upright boiler, and the scale which they were in the habit of removing, was as hard as Portland cement; it broke with difficulty, and had almost a cutting edge. In contrast to this the scale which came down under the motion of the magnet was so friable that it crushed easily between the fingers and could be reduced in one's hand to the condition of fresh mortar or plaster, it being of course, wet when first taken from the boiler. Inside the boiler reaching through the hand holes it could be scraped off the shell, with bare fingers, much as one would scrape fresh mortar or plaster from a newly plastered wall.

The sand-like deposit which was found in the bottom of this boiler was quite free from any mixture of mud as the feed water was perfectly clear, and the deposit afforded excellent opportunities for examination.

Under a microscope the particles seemed to be crystalline in structure, the crystals having more length than breadth, like fragments of dog-tooth quartz.

The scale that was thrown down if carefully handled on account of its great friability and weakness, presented under a strong glass the most interesting illustration of what was taking place. The best comparison that I can think of is a block of ice which has stood in the sun until it has become as we say, "needled" and is ready to break up in long spicule or needles, something we have all seen a thousand times. So it appeared with these scales. A little pressure of the finger on the palm of the hand would reduce them to the sandy particles which made up the mass of what came out of the boiler. Scales from the same boiler and feed water, it should be noted in this connection, before the use of the magnets, were like hard fine grained sandstone, and showed under the glass a homogeneous structure. In a word, the action of the magnetized water upon the scale already formed in this boiler, and also in another very dirty boiler to which I successfully applied the magnetic purifier, was to destroy the "bond" of the scale so that it became weak and rotten like worthless mortar or cement, and in condition to readily disintegrate and fall down in slush or fine particles under the action of the currents in the boiler or otherwise.

I am sorry on some accounts that I am called upon to read a paper of this sort to this convention at this time. It is only three months since I began experimenting with the particular form of magnetic device, the operation of which I have just referred to, and such experiments being made, not in a laboratory, but upon steam boilers that must go from a fortnight to a month before the experimentor can see whether he is on the right track or not, necessarily take a good deal of time. If I had six months longer to experiment in this matter with different waters and under varying conditions I should probably have had material for a more interesting and exhaustive paper, but enough has already occurred under the critical and skeptical observation of myself and others, to make it apparent that in the field of the magnet certain chemical changes of a practical utility to steam users do occur, affecting some and perhaps all waters carrying mineral in solution, and that with a good deal of confidence one may say that another useful application of electricity, or its associate, magnetism, has been added to the daily lengthening list.

[1] Read before the American Water Works' Association at Chicago May 19, 1890.

Another Electric Railway at Rochester, N. Y.

The success of the electric road at Rochester, N. Y., has led to new enterprises in the same line, and electric roads to all the numerous summer resorts about the Flower City may be expected soon. Recently the property owners along the route of the proposed "Rochester and Windsor Beach Electric railroad" held a meeting at the Windsor Beach hotel to talk over the situation. There was a fair attendance, and much discussion. The scheme is to connect with the North St. Paul street cars, and there was considerable debate as to whether the road beyond, which is, for the distance of one and one-half miles, only three rods wide, should be widened one rod to make it equal with the rest. If it be so widened, two tracks will be laid—if not, one track with switches.

There seemed to be a general disposition among the property owners present to grant the right of way in view of the many advantages to be derived from increasing the facilities for reaching the lake on the east side of the river. The general opinion seemed to be that the route would be shorter and pleasanter than that on the west side.

It was also agreed that it would boom property, as the value of land along the boulevard on the west side has more than doubled since the increased facilities for reaching the heart of the city and the lake are at hand. It is proposed to have the electric road run along the river bank, giving the passengers an opportunity to view the finest scenery in western New York

Utilizing the Power of Niagara.

The prospect of utilizing the water power of Niagara at Buffalo leads the *Express* of that city to indulge in the following:

"Imagine this system of electric distribution throughout the city: Electro-motors in every manufacturing establishment, large or small, wherever power is required; electric lamps for light and radiators for heat, and ranges for cooking. The latter is one of the new devices: A cooking range—in which the current is passed through 'resistance coils' of German silver and heats them red hot. All the ordinary cooking operations of a range can be performed by means of this electric fire. The process is, of course, very clean, as the heat is pure and free from smoke and gases. From cooking to the table is an easy step; the hostess can delight her guests at a dinner party by marking their places with full-blown roses, tracing their names in a delicate white line on the leaves; by sending a current through the point of the stylus in writing it changes the color of the leaf. We will also have power to run street railways and power for everybody and everything; with electric sockets at every street corner, so the wires can supply power for fire-engines that have motors for that purpose. This will obviate the great delay of getting up steam after an engine arrives at the scene of a fire." In reference to the results anticipated it says: "The vast machinery throughout the city, which was but a moment before in a state of death-like inactivity is aroused to all the energy of its wondrous life, every part of the complicated organization taking its own peculiar mode of activity, and evolving its own special product, in virtue of the share it receives of the one general force distributed through the entire aggregate machinery."

Electric Tanning.

The following, taken from the London *Electrical Review* is given for what it is worth:

"On May 14, the British Tanning company (limited), who own the British patents of M. M. Worms and Bale, issued invitations to the members and press of the tanning, electrical and allied trades, to inspect their works at Rothsay street, Bermondsey, and see the process of rapid electric tanning in operation A considerable party of visitors, numbering nearly a hundred, were present, including several well-known tanners. They were first shown a drum containing tan liquor of the required strength, into which a pack of Australian salted hides, unhaired and cleaned in the ordinary way, were put. The drums employed are 11 feet 6 inches in diameter by 8 feet wide, and contain an electrode running round the interior of one end or head, from which the current passes through the liquor to a similar conductor on the other head

"The drum was set in motion, and a current of 10 amperes passed through the liquor. The action of the current which is applied is partly to promote diffusion and partly to electrolyze the liquor. Both these effects, aided by the rotation of the drum, are no doubt the explanation of the remarkable saving of time effected by this process, it being possible thus to tan skins and hides in from 24 to 144 hours, against 4 to 15 months by the old process of steeping in pits. A drum was opened which had been running for a little over five days, sections of the hides (salted Australian) were cut and examined by tanners present, and found to be thoroughly tanned. The visitors then inspected the drying sheds and shops above, where leather was seen in all stages, rolled for sole leather, curried, etc., also some hides prepared for machine belting, as, according to some tests shown us by Conrad Falkenstein, manager at Rothsay street, the tensile strength before breaking, taking the average from a number of samples, was equivalent to 4,305 pounds per square inch for the electrically tanned leather, against 3,570 to 3,800 for leather tanned by the ordinary process. The leather is now being sold in the market, and is steadily taking its place in every branch of the trade. The company has an exhibit at the Edinburgh Exhibition, where samples of rough and dressed leather tanned by this process are on view."

A recent dispatch from St. Louis says: A company has been formed there for the purpose of manufacturing and introducing a hydraulic street car motor The inventor of the motor is A. C Atwood of St. Louis, and the new concern is known as the Atwood Electric company. The pumps with which the hydraulic pressure is exerted are to be operated by electricity, and the hydraulic engines are to be connected directly to the axles of the trucks of the car, thus obviating the heavy gearing that is used in the electric motor. Two tanks, each containing about one-half a barrel of water, will be used on each car.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 31.—The necessity of a system of rapid transit to the upper end of Manhattan Island and the almost insurmountable difficulties attending the construction of such a system is directing the attention of the people to the advantages of electricity. The Rapid Transit commission held a meeting Wednesday at Steinway Hall, and all the members were present. In twenty-five days mor the route and character of the road to be built must be determined and within thirty days thereafter the corporation may be formed and the stock books opened for subscription. Each member of the commission has set himself personally to the task of solving the problem of a practical system of rapid transit and the obstacles which are to be overcome point clearly to the adoption of electricity. It is definitely determined that a four track road is necessary to insure genuine relief, and upon this conclusion rests every scheme. The suggestion of a viaduct system which shall extend the entire length of the island is an ideal project but it is impracticable as it would necessitate the purchase of the right of way through solid blocks of immense buildings. Inasmuch as there are no remaining streets available for an elevated system, engineers are considering the best scheme for an underground road. William Steinway, one of the most active workers on the commission, says: "All the difficulties seem to point to an underground road, or partly underground road at least, as the only practical plan, the only solution of the problem. But then when you speak of an underground road, there are so many people who have traveled on the underground road in London, and these hold up their hands in holy horror and exclaim: 'Think of the gas and the smoke and the steam and the oil and the indescribable combination of horrible smells—and the darkness which is only emphasized by the pale flickering gas lights in the tunnel and the trains' They know of no other kind of underground railroad and fail to appreciate what electricity may do for us both in illuminating such a tunnel and in supplying motive power to do away with such objections to an underground road as are encountered in London."

At a meeting of the representatives of the manufacturers of mechanical rubber goods in the United States it was determined that owing to the reduced receipts and the increased consumption of crude rubber, prices on manufactured goods should be increased 10 per cent. to take effect June 2. The New York Belting & Packing company, the Boston Belting company, the Gutta Percha & Rubber Manufacturing company, the New York Rubber company, the Boston Water Hose company, the Trentoo Rubber company, the Mercer Rubber company, the Cleveland Rubber company and B. E. Goodrich & Co., discussed the question of a further advance to take effect in June.

Port Richmond, Staten Island, was the scene of an immense demonstration to celebrate the advent of electric lights in the streets of that place. It is said that more than 5,000 persons gathered along the line of march, and nearly all the houses along the line were gaily decorated with Chinese lanterns and bunting. Rockets and fireworks of every description vied with the electric lights which were turned on for the first time. The parade was nearly three-quarters of a mile long, and passed through the principal streets of Port Richmond, Erastina and Elm Park.

W. H. T.

Kansas City, Mo.

KANSAS CITY, Mo., May 31.—Secretary Ray of the Board of Public Works recently sent out a great number of inquiries concerning the cost of street lighting, many of which have elicited replies from officials of the cities to which they were addressed. The statements received have been tabulated. The subjoined table exhibits the prices paid per night by the cities named for nominal 2,000 candle power arc lights burning all night:

	NO. OF LIGHTS.	PRICE.
Kansas City	114	$.55
St. Louis	1,577	.20½
Philadelphia	1,045	.47¾
New Orleans	634	.34 3-10
Omaha	100	.47 3-10
Denver	216	.53
Buffalo	1,296	.40
Montreal	850	.40
Pittsburg	902	.28¾
Providence, R. I	500	.44
Cleveland, O	100	.38
Baltimore	607	.40
Sioux City	75	.28
Toledo	520	.27¾
Memphis	100	.50
Duluth	186	.35
Syracuse	304	.40
Galesburg	118	.32½
Birmingham	100	.33⅓

The Kansas City Electrical society met in regular session last week. The work of this society is steadily progressing, and new members are constantly being enrolled. Thus far the society has been able to provide an excellent course of lectures which have not only been received with appreciation by the members and their friends, but have secured from the general public a recognition which is gratifying and encouraging. The public profits by these meetings, as the employes of the various companies meet and discuss their experiences and troubles, and an increase in efficiency of the electrical service is the result. T. F. Clohesey's paper on "Electrical Tests" was postponed until the next meeting. President W. W. Smith, L. H. Gamp and E. Monahan had the close attention of the society for two hours during which they dwelt upon electric light and telephone problems.

A telephone operator said recently: "One lady called me up the other day during a storm, and remarked: 'I know why I can't talk to-day in this rain. It is because the water dropping off the wires carries the electricity with it.' About the same time another one wanted to know if the plumbers working in the cellar with a great coil of lead pipe would hurt the telephone. I told her that it might, and I'll guarantee that she stopped the workmen. A lady living on the East side telephoned the other day saying: 'The pole on which our wire is leans, and the wires slacken. This interferes with my conversation, and I wish you would fix it.' A lady living on Grand Avenue recently wanted the wires taken off the metal roof of her house. Her complaint was that last week some of the electricity had dropped down and burned a hole through the roof."

The application of the Missouri & Kansas Telephone company for a twenty year franchise to operate telephones in Kansas City, Kas., was taken up at the last meeting of the council in that city and toyed with by the councilmen. The twenty years' term was cut down just one-half, then the section giving the company the exclusive right to one side of the street was ruthlessly slaughtered. The company was restricted to the use of alleys whenever those narrow thoroughfares could be used. The use of the top arm on all poles was demanded for the city. The company agreed to furnish the city two free telephones, and to only charge one-half rate for all others in use. Under no circumstances will the city pay over $50 per year for an instrument. The ordinance was then passed.

The Moberly, Mo., gas works were sold last week under deed of trust by Adam Given, trustee, to Hammett & Davison, of this city, for $22,500. Mr. Hammett stated that the firm had bought the electric light plant of that city, and that this plant and the gas works would be consolidated.

A large force of men has been engaged in substituting copper for iron wires for the Western Union Telegraph company's system in this city. About 300 miles of copper wire will be put up within the city limits. The cost will be $15,000 to $20,000.

P.

Salt Lake City.

SALT LAKE CITY, May 29.—The outlook for rapid transit in Salt Lake city is encouraging. A million dollars is now being invested in electric equipment of the street railway lines. Two principal companies are doing this work—the Salt Lake company and the Rapid Transit company.

The Salt Lake company has already laid two miles of track to the Warm springs, and is placing a double track on Second south and on Sixth east to the Rio Grande Western depot. The First south line runs from Seventh east to the Utah & Nevada railway. There is also a switch three blocks long running from Second to Fifth east. The next move will be to equip the Sixth Ward line, which runs on Fifth south to Liberty Park with electrical apparatus. This company has 25 miles of road in operation, five miles of which was constructed this year, and the franchises now in possession cover forty miles. It is running regularly eighteen electric cars, and six mule cars, but the latter will soon be taken off to make way for the electric cars. The old mule cars are being converted as fast as possible into trail cars. Twenty new electric cars are on the way, which, with the two extras on hand, will give them a rolling stock of forty cars. Five of the new cars will be open excursion coaches, and are supplied with double motors. Both single and double motor cars will be operated on this company's lines, the double motors drawing a trail car. "Every preparation is being made," said J. S. Wells, secretary and treasurer of the company, "to raise $600,000 to pay for improvements already made and those contemplated." The power station has been greatly improved and the capacity enlarged by the addition of four dynamos of 100-horse power each. This company supplies power to the sewerage pumping station and to other concerns for manufacturing purposes.

The Rapid Transit company is forging south on the State road at the rate of over a mile a week. The double track will extend from Eagle gate to Seventh south, and the single line goes to the city line. The company is employing 85 men, and will construct during the season thirteen miles of road and expend $150 000. The company is fortunate in securing as superintendent C. C. Upman, who served the Chicago & Burlington as its chief engineer, and at one time was the superintendent of the Chicago, Burlington & Quincy.

The activity displayed by the street car companies of Salt Lake City is certainly commendable. The equipment of the roads with electrical apparatus will add much to the prosperity of the city and increase the value of suburban property for residences.

R.

Pittsburg, Pa.

PITTSBURG, Pa., May 26.—The Hill Top Street Railway Traction company has just been organized in this city for the purpose of building a new street car line up Mount Washington. The only road leading up this mountain is a very steep winding path, and the incorporators are now closely investigating the relative advantages of the cable and electric systems for their project. The line will be about three miles long and serve as a feeder to the Birmingham street car line.

L. B. Stillwell, electrician of the Westinghouse Electric company, left a few days ago for England where he will be for some time occupied with the Westinghouse Electric company, limited, of London.

The chief of the department of public safety in Pittsburg has recently unearthed an ordinance which he says gives him the right to proceed against the telephone, telegraph and electric light companies whenever they injure any trees or shrubs, while putting up poles for their wires, and he says he intends to enforce this ordinance.

The Elizabeth Electric Light company of Elizabeth, Pa., has broken ground for the erection of its plant.

A charter has been granted to the Tarentum Traction Passenger Railway company of Tarentum, Pa. The capital stock is $50,000, and the object of the organization is to build an electric road.

A dozen citizens and business men of Washington, Pa., had a notice served upon them a few days ago by a private detective of the Bell Telephone company that they must surrender their telephones as they do not belong to that company and are infringements upon its patents.

The case of the Pittsburg Traction company against the Duquesne Traction company came up before Judge White of this city a few days ago. In this suit the former corporation asked the court to enjoin the latter from laying their tracks on certain streets in the city because they had prior rights. The judge in a lengthy opinion refused the injunction, and the case has gone to the Supreme court.

The new government building in this city, which has gained a questionable yet national notoriety because it has been for fifteen years in progress of erection, is now almost completed. A few days ago, J. E. Powell, superintendent of electricity of the treasury department, Washington, arrived here to make preparations for the wiring of the building.

On Monday, May 26, the stockholders of the Pittsburg & Allegheny Traction company held a meeting to increase the capital stock of the company to $3,000,000. This is one of the oldest and most prosperous street car companies in Western Pennsylvania, and the increase of the capital is necessitated for the purpose of converting the line into an electric road.

G. H. Blaxter, the general manager of the Allegheny County Light company, will leave for Europe early next week. Mr. Blaxter will be absent for six weeks visiting the haunts of his youth in the county of Devonshire, England.

The third electric road is now in operation in this city. This is a feeder of the Pittsburg Traction company, leading from Oakland to Linden, a distance of one and a half miles.

During the very heavy thunderstorm last week, a good deal of damage was done to the local police, fire alarm and electric wires generally. The fire alarm especially was in a bad condition, and had a fire occurred immediately succeeding the storm, there would have been great difficulty in sending in an alarm. Prompt attention, however, was paid to the defective wires and all the damage repaired. A large part of the force of the bureau of electricity worked at night to do the necessary repairing.

A few days ago testimony in the suit of the Edison Electric Light company against Westinghouse, Church, Kerr & Co. of New York, which is pending in the courts of New Jersey, was taken before United States Commissioner Gamble in this city. The case involves the alleged infringement of a patent for an invention used in the distribution of electricity by the continuous current system. By testimony taken here, it was endeavored to show that the same patent had been used in the gas and water system of

Pittsburg previous to the time at which the patent in question had been invented by Edison.

Among the latest improvements made by the Allegheny County Light company of this city is a photometer room, which is somewhat of an innovation as an accessory to a central station plant. The company has given this experiment a thorough test and finds it to meet with great appreciation on the part of its patrons. The company not only tests the vacuum and candle power of all new lamps, but also returned lamps are examined and if the carbon is found to be still intact the lamp is quickly put into working order again. Over 100 lamps are thus tested each day.

The new switch board of the company has quite a number of advantages, but it recommends itself especially for its compactness, and the facility with which everything can be handled and its systematic arrangement. The board consists of two separate parts, a lower front part, which is smaller, and a larger one arranged behind covering an entire wall. On the lower front portion of the switch-board are the dynamo regulators, representing the regulating machinery for eight 3,000-light Westinghouse alternate current dynamos. Behind and above this are the circuit regulators for 20 circuits of 2,000 lights each.

There are, however, three 3,000-light machines of the company run from the Allegheny branch of this station, affording in this way facilities for regulating dynamos of 33,000 lights' capacity and a circuit regulation of 40,000 lights.

The Second Avenue & West End Street Railway company of this city is extending its lines with great rapidity. When plans now mapped out shall have been completed this company will have the longest street car line in Western Pennsylvania. It is the intention to run the West End line to Crafton and Mansfield, a distance of ten miles. This line is at present operated by horses but the electric system will be placed in use with the least delay possible. The Second avenue line is to be extended to Homestead, ten miles distant from Pittsburg and just across the river from Glenwood, the present terminus of the line. Once all this is done, a passenger can get in a car at Mansfield and ride to Homestead, 20 miles distant, on the cars of one corporation. E. H. H.

Louisville, Ky.

LOUISVILLE, May 27.—The *Evening Post* is authority for the statement that an Eastern syndicate is after the entire street car system of this city. There are two companies which, after years of fighting, are practically combined. They are the Louisville City Railway and Central Passenger Railway companies, the latter owning the only electric line now in operation here. Including suburban tracks the combined companies operate and own 151 miles of lines, and carry annually 20,000,000 to 30,000,000 people.

The Central Passenger Railway company now owns the only belt line in practical operation. It is about seven miles long and traverses all the best portion of the city. It is now being arranged for electric cars. The rails are being connected with wires as fast as put down. The streets along the belt are being now torn up in many places for reconstruction purposes. It is not known yet whether the overhead system will be used or not. A great deal of objection was made by the telephone people and the public generally at the overhead wires on Green street.

The Brook and Seventh street, or belt line, will be made an electric line in any event, whether the deal with the Eastern syndicate is made or not, but the *Post* says editorially that, in addition, the meaning of the sale, if it is made, is the use of electricity for all street railway lines in the city.

The trouble experienced by the telephone company from induction by reason of the electric railway circuits has been overcome in a great measure by an underground conduit system. All the telephone wires in this city are being put under ground as rapidly as possible.

There is serious talk here of substituting electricity for gas in this big city. It seems to be only a matter of time when this will be done, and a great many think it will not be long.

At Richmond, Ky., Messrs. Woodbury, Moulton and Boardman have purchased the gas works, water works and electric light franchises. Electricity will probably supersede gas entirely, except for consumption in private houses L.

During the convention of the American Waterworks association at the Grand Pacific Hotel, Chicago, last week, the delegates had an opportunity of examining the alternating system of the Thomson-Houston company. The Chicago office had fitted up one of the hotel parlors with an elaborate display of incandescent lamps in colored shades, brilliantly illuminating the room and the hall leading to it. It attracted much attention, and evidently made a favorable impression on the delegates.

THE ELECTRIC LIGHT.

The Cicero Gas & Electric Light company has filed a certificate of increase of capital stock with the secretary of state at Springfield, Ill.

The Citizens' Electric Light company of Braddock, Pa., has purchased of the Westinghouse Electric company a 750 light alternate current dynamo.

Saco, Me., has adopted the Westinghouse alternate current system. The initial plant at Saco will consist of one 750 light incandescent dynamo.

The Westinghouse incandescent light is to be employed at Bar Harbor on the coast of Maine. The Westinghouse Electric company has just closed an order for 2,250 lights.

Fort Dearborn Light & Power company has been formed at Chicago, to buy and operate electric machinery, etc; capital stock, $25,000; incorporators, A. L. Baker, E. F. Bunyan and S. T. Parks.

The Chicago Edison company has installed an isolated plant in Otto Young & Co.'s store on State street, Chicago. A 270 light dynamo, driven by a 45 horse power Ideal engine, has been placed in the basement of the building.

The Royal Electric company is making rapid progress introducing electric lighting in Canadian cities. The last victory achieved was at Three Rivers, where a contract for a plant was given by the city. The installation will cost $35,000.

It is claimed that the electric lighting companies of New York City have increased their business more during the last year than many previous years, despite the hardships encountered through the opposition of the Board of Electrical Control.

Laconia, N. H., has recently shown her enterprise in the organization of an electric light company, which has since awarded the contract to the Westinghouse Electric company for the furnishing of alternating current apparatus of 1,250 lights' capacity.

From the present outlook it is quite probable that many of the residences on the principal streets of Wooster, Kan., will soon be lighted by electricity, as the Wooster Electric company have decided to increase the capacity of their incandescent plant.

The trustees of Middlebury, Vt., recently decided to adopt electric lights for illuminating the streets of the village. The first bid received in connection with the new system was from an office seeker who desired the position of "lamp lighter."

The Wilmington City Electric company of Wilmington, Delaware, has for some time been contemplating extensive improvements in its electric light plant. The company has just contracted for a new 750 light machine, Westinghouse alternate current incandescent system.

The following are among the recently established central station electric light plants operating the Westinghouse alternating current system: Crafton, W. Va., 500 incandescent lights; Lebanon, Miss., 500 incandescent and 40 arc lights; Emaus Borough, Pa., 25 arcs; Negaunee, Mich., 25 arcs.

Owing to the rapid increase in the business of the Brush Electric company of Baltimore, that organization has found it necessary to increase the capacity of its incandescent plant by the addition of a Westinghouse 3,000 light alternate current dynamo. This machine will be shipped immediately.

The Salem Electric Light, Heat & Power company of Salem, N. J., after having for nearly three years been running a very successful incandescent plant has just decided to go into the arc lighting business also. The company has just contracted with the Westinghouse Electric company for one of its new arc machines.

The Electric Light & Power company of San Antonio, Tex. has been in operation since 1887, and it was one of the pioneer plants in this country adopting the Westinghouse alternating current system. The company has lately been obliged to make some enlargements in the plant and added new Westinghouse apparatus of 850 lights' capacity.

The Lowe-Geeding Electric company of Neosho, Mo., have recently sold a plant for lighting the railway platforms at Neosho Junction, Mo. The system includes both arc and incandescent lights. The company has sold a 50-light plant to the Freeman Machine company of Joplin, Mo.; a 25-light plant to the Galesburg Milling company, and a 50-light plant to C. W. Likins, Everton, Mo.

The prospects of electric lights for Lebanon, Mo., filled the residents with so much joy that they got up a celebration. A dispatch says: The Knights Templar band in full uniform is parading the streets to-night and filling the air with music in ratification of the adoption of the electric light franchise. The unanimity of the citizens upon the adoption of this measure, there having been but four votes cast against it in a total of 322, is something remarkable. The city is to have 23 arc lights, and nearly every resident will take the light, while no business house will be without it.

The Thomson-Houston Electric company reports the following sales: Hammond Milling company, Hammond, Ind., 50 direct incandescents; Kalamazoo Electric company, Kalamazoo, Mich., 650 alternating and 50 arc; Gratwick, Smith & Fryer Lumber company, Oscoda, Mich., 350 direct incandescents; J. P. Anderson, Trenton, Mo., 30 arc and 650 alternating incandescents; Joliet Wheel company, Joliet, Ill., 5 arc; Moffett, Hodgkins & Clark, La Grange, Ill., 650 alternating incandescents; Battle Creek Electric company, Battle Creek, Mich., 35 light arc; Salt Lake Power, Light & Heating company, Salt Lake City, Utah, 30 light arc and four 650 light alternating incandescents; G. F. & E. A. Burkhart, 196 W. Twelfth street, Chicago, 35 direct incandescents; C. Hebard & Son, Pequaming, Mich., 150 light incandescent motor type dynamo; Marysville Electric Light & Power company, Marysville, Cal., 650 light alternating; Swanton & Clark, Santa Cruz, Cal., 650 light alternating; D. C. Metsker, Sedalia, Mo., 650 light alternating.

Connersville, Ind., is to have the electric light. An electric light company recently organized at Connersville, Ind., has closed negotiations with the Westinghouse Electric company for a 750 light incandescent dynamo and two 40 light arc dynamos, all machines to be of the alternate current type. J. W. Huston, treasurer of the United States, is the president of the Connersville company.

The San Antonio (Tex.) Gas company, having purchased the plant of the Electric Light & Power company of San Antonio, is remodeling its electric light department throughout. It has contracted for a 320-horse power Westinghouse compound condensing engine and 700-horse power Holyoke Deane condenser, and two 750 light Westinghouse alternating dynamos. The erection of the plant will be under the direction of J. H. Gates, general agent of the Westinghouse Electric company. The Las Vegas (N. M.) Gas company has recently placed an order with J. H. Gates, general agent of the Westinghouse Electric company, for a 750-light incandescent alternating dynamo, a 40-light alternating arc machine, and a 100-horse power Westinghouse compound engine. This company has obtained the contract for the street lighting.

THE ELECTRIC MOTOR.

The New York *World* opposes the granting of franchises to cable companies in the metropolis. It calls attention to the fact that the Westinghouse company has entered the field of electric street railways, and anticipates lively competition. Gotham badly needs electric roads.

The Chicago Arcade Rapid Transit company has been incorporated, and it is claimed that $8,000,000 stock has been subscribed. This company announces its intention of constructing an immense system of overhead and underground railroads in Chicago. Definite plans are not obtainable, however.

George M. Pullman has been in New York recently, and George Westinghouse, Jr., has been in Chicago within the last few weeks. Neither of these gentlemen have announced their plans to the public, nor is there any probability they will, yet the newspapers have been presenting "information from reliable sources" about the plans of these gentlemen. The most singular thing about these reports is that the "reliable sources" present conflicting statements.

A. Davis, formerly of the North Shore Railway, has completed plans for an elevated electric railroad for Montreal, and has secured patents for the inventions which are the distinguishing features of the system. The track is elevated on a series of single posts 60 feet apart. Single girders, resting on these pillars and sunk 6 inches into their heads, carry the rails. A distinctive feature of the system is the provision for supplying the motive power to the cars. The cable for conveying the electricity runs along the top chord of the girder. The cross-ties, instead of being fastened to the top of the girder, are passed through the lattice work, so that the upper portion of the girder projects to within an inch of the bottom of the cars. The motor is fastened under the center of the car, and the electricity is conveyed to it by two wheels, which grip the cable and can be regulated from the interior of the car. The wheels are also completely free from brake friction, as the brake system consists of a pair of shoes adjusted so as to grip the top chord of the girder on either side. The motor can be made to work direct by steam-propelled cable or by electricity.

Henry C. Payne's visit to New York has given rise to the story that he was negotiating the sale of the Milwaukee City Street railway to the syndicate represented by Henry Villard. The dispatches from New York say: "It is rumored that besides the sale of the street railway the Edison Electric Lighting company of Milwaukee is to be transferred to the syndicate and both operated under one management, of which Mr. Payne will be the executive chief. It is understood that the Sprague system of propulsion will be introduced as soon as possible, and that the cost will be about $950,000. The price paid for the two properties is not known, but it is said to be $1,500,000. The Milwaukee dispatches do not positively deny the rumors. Chas. Ray, president of the Edison Illuminating company of Milwaukee, said that so far as he knows there is nothing in the reported sale of the Milwaukee plant to Henry Villard. The sale of the Cream City street railway to a Pittsburg syndicate was consummated May 1, and at the time of the sale it was currently rumored, and the rumor was given considerable credence because of Mr. Villard's presence in Milwaukee at the time, that Mr. Villard represented the syndicate which purchased the road. Since the transfer of the road there is no one in Milwaukee who can speak with authority. Henry C. Payne retired from the presidency of the Cream City road when it was sold."

The Thomson-Houston Electric company has recently finished the equipment of the following roads on which the cars are regularly running: Georgetown & Tenalleytown Street railway, 6 cars and 6 miles; Vancouver Electric railway, Vancouver, B. C., 4 cars and 3.50 miles; Utica Belt Line Railway, Utica, N. Y., 25 cars and 20 miles; Milwaukee Cable company, Milwaukee, Wis., 12 cars and 15 miles; Knoxville Street railroad, 5 cars and 3.40 miles; North Side railway, Fort Worth, Tex., 15 cars and 15 miles; Attleboro, North Attleboro & Wrentham Street railway, 5 cars and 6.50 miles; the Albany railway, Albany, N. Y., 32 cars and 14 miles. The power station at Albany is one of the finest which has been built for electric railway purposes. It is a substantial brick building, divided by a brick wall into two rooms, one containing the battery of boilers, and the other engines, generators and electrical appliances.

The boilers are ten in number, and have a total of 1,250-horse power. There are six engines of 200-horse power each. The generators are twelve in number, two being belted direct to each engine, and are capable of producing 80-horse power each. The boilers, engines and dynamos rest upon brick foundations, which are supported in beds of concrete two feet in thickness, which obviate entirely all tendency to vibration which is usually found in the operation of heavy machinery. The plant throughout in every detail is constructed in the most thorough and substantial manner, and this, as well as the motor cars, have given the utmost satisfaction since the start. The power house was designed by and built under the direction of L. H. McIntire, the engineer of the Thomson-Houston Railway Engineering Department.

THE TELEPHONE.

The Bell Telephone company of Canada has concluded a contract for the construction of metallic circuit between the Dominion and provincial capitals. The lines will run over Montreal, and when they are completed conversation can be carried on over 230 miles, the longest distance yet attempted in Canada.

The Wisconsin Telephone company had an unpleasant experience at its Milwaukee exchange Thursday, May 29th. One of the telephone wires broke and dropped across the electric railway company's wire. The result was that a section of the switch-board at the telephone exchange was burned out and the service greatly impaired, temporarily. The operators were thrown in confusion by the accident, and all were thoroughly frightened. It was unquestionably the most serious disaster that ever happened the exchange.

THE TELEGRAPH.

The 600 bucket-shops which have given up the ghost within the last seven weeks, it is said, have paid an aggregate of nearly $1,000,000 per year for telegraphic service rendered by the Western Union. The retiring of the rest will probably make as much more difference in the receipts of that company, and it would seem to be only a question of a little more time when they will all go.

A London cablegram says: "A large block of commercial cable stock has been sold to a London syndicate composed of capitalists interested in the Canadian Pacific railway, and to-day Sir Donald A. Smith, W. C. Van Horne and C. R. Hosmer of Montreal, and Thomas Skinner of London, were elected directors to represent this interest. John W. Mackay still personally holds more than one-half of the capital stock."

S. G. Doran, president of the recently collapsed Doran & Wright company, New York, whose failure created quite a sensation among brokers in all parts of the country, was a poor telegraph operator not many years ago. He was known as "Doc" Doran among his associates, and the name clung to him in his more prosperous days. He started out from Iroquois, Canada, about fifteen years ago, with a few thousand dollars, to make his fortune. He did not succeed at once, however, and was soon left to his own resources. After two or three unsuccessful ventures he learned telegraphy and secured employment in Rochester, N. Y., where he first started in the brokerage business. He had learned the business while acting as telegraph operator in a bucket shop in Rochester, and with the assistance of E. R. Thompson opened an office under the firm name of Doran & Thompson. Since that time he has occupied a prominent position in the financial world. He has been generally successful, and it is thought that he will soon resume his old position in financial circles.

A. B. Chandler, president of the Postal Telegraph company, is reported as saying that the lines of that company will soon be extended in every direction. At present the Southern states are receiving special attention, and the work in that section is being vigorously pressed. A large circuit which is soon to be completed extends from Cincinnati to Louisville, to Chattanooga, to Rome, Ga., and also from Chattanooga to Nashville, to Memphis, to Meridian, also Jackson and Vicksburg to New Orleans. Work on that route is being pushed as fast as possible. The Postal is also building a line from Kansas to Topeka, to Hutchinson, to Pueblo, to Denver, and an important consultation will be had in a few days of the officers of the company. The purpose of the company is to determine how soon wires from Denver will be extended to Salt Lake and then to Ogden. At present the feeling among the officers of the company is to begin work at once, but it may be delayed until next year. After Ogden is reached the question of tapping California is simple. The Pacific Postal Telegraph company has an extensive network of wires through the state and the Postal will undoubtedly come to some arrangement whereby the whole system will come under one general head. When California is reached by the central route, as it will be known, the Postal people say that their facilities for handling business will be greater than that of the Western Union. They intend to use good copper wire and the poles will be well set and close together. They will build under the government law of 1866. They will not build alongside the Union Pacific but somewhat south of it, on the highway. This, Mr. Chandler thinks, will be an aid as the service then will not be so much subject to interruptions by storms. Besides surveying routes throughout the country and constructing new lines, the Postal is negotiating for the purchase of private and railroad lines wherever possible. Negotiations with the railroad company in the south for the sale of a stretch of 900 miles have just closed, and that with the right of way with the poles and wire and instruments is now the property of the telegraph company. The Postal now relies in the main on the Canadian Pacific Railway company for dispatch of its business to the West. The Postal, of course, will still use that route in conjunction with the proposed new one.

Miscellaneous Notes.

The Worrall Electric Construction company has been incorporated to construct and maintain electric plants; capital stock, $500,000; incorporators, C. E. Gaylord, M. J. Frost and C. T. White, of Chicago.

A Washington correspondent writing about the curiosities of the patent office, says much wonder is expressed by visitors on beholding the marvels of electric welding exhibited there. The new process is illustrated by a large number of examples.

The severance of the New York Electrical society from the American Institute, of which it has for some years been the electrical section, has put an end to a somewhat embarrassing confusion. The resemblance between the titles "Electrical Section of the American Institute" and the "American Institute of Electrical Engineers" resulted in a great deal of inconvenience to each body, not to mention the puzzling difficulty frequently experienced by the public in distinguishing between the two. The New York Electrical society will henceforth be known by the distinctive title under which it began its career.

A game of base ball will occupy the attention of the representatives of the Westinghouse interests in Chicago during the remainder of the season. A challenge to a combat has been passed from the Westinghouse, Church, Kerr & Co.'s men to the Westinghouse Electric company's representatives, and the latter have signified their intention to accept the call. It is expected the game will be played before the World's Fair. In the meantime W. H. Pearce and F. E. Degenhardt are exchanging compliments, and from a glance at the correspondence there is no indication of failure of either gentleman's vocabulary.

"This is the day of big things," says the *Engineering and Mining Journal*. This is true especially in regard to electrical and steam engineering, according to the same authority, and it cites, as an illustration, the fact that there was recently built a Corliss engine "of 5,000 horse power, vertical type, and stands forty-eight feet high. It is designed to drive the Ferranti dynamos, forty-five feet in diameter. The West End Electric railway station in Boston is to have thirteen engines of 1,000 horse power each. They are to be triple compound, with cylinders 21, 36 and 52 inches in diameter. The power is transmitted by two belts for each engine, each belt five feet wide. Steam will be furnished by twenty-four water-tube boilers, each rated at 500 horse-power." Other instances are cited as follows: "The Ferranti dynamos used in the Deptford lighting stations weigh 500 tons each. Two dynamos of 10,000-lamp capacity are being made for Berlin, each of which will require about 1,000 horse power. There are no data now existing which will enable any one to predict what will be the size of boilers, engines, dynamos, steamships, bridges, cars, locomotives, office buildings and other structures ten years hence.'

Business Mention.

The National Galvanic Battery company of Cincinnati has removed from 239 and 241 Main street to 175 Plum street, between Fourth and Fifth.

The Central Electric company of Chicago has recently taken an order for 1,000,000 feet of okonite wire. The company also has sold an entire Caodee wire equipment for an electric railway system.

The entire business of the Leonard & Izard company has lately been transferred to the Central States district of the United Edison Manufacturing company. The Leonard & Izard company has therefore ceased to exist.

H. T. Paiste of Philadelphia, left New York on the steamer Teutonic last week for a four months' business trip in Europe. His principal object is to introduce the Paiste switch. He has already started a factory at 11 Union Mews, Union street, London.

James W. Queen & Co. of Philadelphia have just issued a new catalogue and price list of electrical testing apparatus. Special attention should be called to the standard resistance boxes, portable testing sets and photometers. The firm will send the catalogue to those interested.

The proceedings of the National Electric Light association, at its recent conventions held at Niagara Falls and Kansas City, will be published shortly by the association in two handsome volumes. The Manufacturers' Advertising Bureau & Press Agency, 111 Liberty street, New York, has charge of the advertising.

The Baxter Motor company of Baltimore, Md., state that they are very well pleased with the increase in business in the West. During the past two weeks their shipments to this section of the country have been unusually large, and have, if anything, shown larger gains than with the Eastern or Northern shipments. The outlook for the future is very encouraging, especially for the arc motor.

C. H. Holmes & Co., of St Louis, report sales of cedar poles for the electric street railway at Springfield, Mo., also for the electric road at Pittsburg, Kan. They have about completed their contracts for poles with the Union Depot and Lindell Railways of St. Louis, and report the demand far in excess of last year, both for street railway and electric light poles.

The new store of the Great Western Supply company, 190 Fifth avenue, Chicago, is being rapidly put into shape for business. The carpenters and cabinet makers are building the necessary bins for stock and are fitting up the new and handsome offices which will occupy a portion of the second floor. This company has now on the way from the manufacturers over five full car loads of goods, comprising all kinds of electrical supplies. These are expected in the early part of this week and will be rapidly arranged on the different floors. Mr. Cutter has arranged a temporary office at the west end of the second floor where he is transacting business, and feels very much encouraged by the outlook. C. G. Armstrong has accepted the position of manager of the electrical house goods department.

A fire in the building occupied by the Sperry Electric company, Chicago, cut off the power recently but did not damage any of the machinery. The company is now comfortably located on Canal street, Chicago, between Jackson and Van Buren streets, and has one of the best factories in the country. Both shops and offices are well lighted and ventilated, and there is ample room and every facility for shipping. The company has a number of large orders ahead, and the prospects are unusually inviting.

The Ball Engine company of Erie, Pa., recently shipped the Northwestern Guarantee Loan company of Minneapolis, Minn., two 100 horse power engines for electric lighting for the company's beautiful block now in course of construction. The Cleveland Arcade company of Cleveland, O., is putting in three large Ball engines. The Rockport Water company of Rockport, Ind., has just received from the Ball Engine company a 60 horse power engine. The Greenwich Gas & Electric Light company of Greenwich, Conn., is just putting in a 100 horse power tandem compound engine, supplied by the Ball company. The Pensacola Electric Light company of Pensacola, Fla., has just added to its plant a 100 horse power Ball engine. The Manitou, Colo., Springs Electric Light company are putting in one 80 and one 100 horse power Ball engines. The Tuscarawas Electric Light company, Canal Dover, Ohio, are putting in a 100 horse power Ball engine.

W. R. Molinard of the lately reorganized Baxter Electric Motor company of Baltimore, Md., has made arrangements with Chas. H. Cone, Chicago, to represent his company in the West. Mr. Cone is well known to the fraternity and the arrangement will doubtless prove satisfactory to all parties concerned. It will be remembered that the Baxter motor was on the market some time ago and built up a reputation for itself in Chicago as a thoroughly high grade machine. As the reorganized company now stands it is in the position to place its machines on the market in better shape than ever. With an efficient representative in Mr. Cone it is prepared to supply a machine that will be a credit to the manufacturers. The company is now preparing for an extensive agency system. It purposes having a resident representative in every important city and town where current is available, so that consumers of power in small quantities will have every opportunity of being supplied with a satisfactory machine and of having their interests cared for after its installation.

The Westinghouse alternating current apparatus for central station plants has been installed in the following places outside of the United States and Canada: London, England, 25,000 lights; Canton, China, 1,500; Halifax, Nova Scotia, 1,400; Havana, Cuba, 4,500; Juiz de Fora, Brazil, S. A., 1,500; Santa Anna, Salvador, C. A., 500; Sansonate, Salvador, C. A., 500; Shidzuoka, Japan, 1,500; Vancouver, B. C., 750. The Westinghouse alternating current incandescent system has now been established in nearly three hundred central station plants throughout the country, with a total capacity of almost six hundred thousand 16-candle power lamps. Of these stations the following have a capacity exceeding 1,000 lamps: Albany, N. Y., 1,300; Allegheny, Pa., 13,000; Allentown, Pa., 1,500; Amherst, Mass., 1,500; Annapolis, Md., 2,250; Aspen, Col., 1,400; Auburn, Me., 2,250; Austin, Tex., 5,200; Baltimore, Md., 5,000; Batavia, N. Y., 1,250; Bath, Me., 1,400; Bay City, Mich., 1,500; Beaver Dam., Wis., 1,300; Binghamton, N. Y., 3,000; Birmingham, Ala., 1,000; Boston, Mass., 3,750; Bristol, Pa., 1,000; Buffalo, N. Y., 3,250; Butte, Mont., 2,250; Carbondale, Pa., 2,050; Cedar Rapids, Ia., 2,050; Chattanooga, Tenn., 1,960; Clinton, Ill., 1,400; Colorado Springs, Colo., 3,450; Columbus, O., 2,600; Conshohocken, Pa., 1,300; Connellsville, Pa., 1,500; Cornwall, Ontario, 1,300; Council Bluffs, Ia., 2,250; Dansville, N. Y., 1,000; Denison, Tex., 1,500; Dennison, O., 1,000; Denver, Colo., 16,800; Des Moines, Ia., 1,000; Dubois, Pa., 1,000; Duluth, Minn., 2,800; Eau Claire, Wis., 1,300; Elmira, N. Y., 1,500. Englewood, Ill., 2,250; Fliot, Mich., 1,150; Evansville, Ind., 1,300; Fort Worth, Tex., 2,800; Galveston, Tex., 1,300; Greensburg, Pa., 1,350; Hagerstown, Md., 1,300; Halifax, N. S., 1,400; Hamilton, Ont., 2,000; Hartford, Conn., 4,750; Helena, Mont., 1,500; Hoboken, N. J., 1,300; Kansas City, Mo., 3,000; Kansas City, Kan., 1,500; Lincoln, Neb., 1,950; Little Rock, Ark., 2,250; Louisville, Ky., 3,000; Mansfield, O., 1,400; Mauch Chunk, Pa., 1,500; Media, Pa., 1,500; Minneapolis, Minn., 4,500; Moline, Ill., 1,500; Montgomery, Ala., 1,300; Morristown, N. J., 1,300; Nashville, Tenn., 5,500; Newark, N. J., 2,250; New Bedford, Mass., 5,600; Newburg, N. Y., 1,500; New London, Conn., 1,400; New Orleans, La., 6,500; New York, N. Y., 53,500; Oakland, Cal., 1,300; Ottawa, Ont., 300; Oxford O., 1,000; Parkersburg, W. Va., 1,950; Peekskill, N. Y., 1,300; Philadelphia, Pa., 2,700; Pine Bluff, Ark., 1,300; Pittsfield, Mass., 1,650; Pittsburg, Pa., 26,450; Pittston, Pa., 1,200; Plainfield, N. J., 3,900; Plattsburg, N. Y., 1,500; Port Jervis, N. Y., 1,400; Portland, Ore., 6,000; Pottsville, Pa., 1,500; Providence, R. I., 7,500; Pueblo, Colo., 2,800; Richmond, Va., 6,950; Salem, N. J., 1,000; Salem, O., 2,050; San Francisco, Cal., 1,300; Sandusky, O., 1,300; Saratoga, N. Y., 1,500; Savannah, Ga., 3,350; Schenectady, N. Y., 4,100; Seattle, Wash., 1,500; Sheffield, Ala., 1,300; Sing Sing, N. Y., 1,300; Sioux City, Ia., 1,400; Skaneateles, N. Y., 1,500; Springfield, Mass., 4,300; Springfield, O., 1,950; Stapleton, N. Y., 5,300; Sterling, Ill., 1,000; Steubenville, O., 2,250; St. Joseph, Mo., 3,750; St. Louis, Mo., 15,000; St. Paul, Minn., 4,100; Tampa, Fla., 1,150; Torrington, Conn., 1,300; Trenton, N. J., 3,900; Troy, N. Y., 1,300; Tyrone, Pa., 1,700; Washington, Pa., 1,250; West Superior, Wis., 1,500; Wheeling, W. Va., 1,950; Wilmerding, Pa., 1,500; Williamsport, Pa., 2,250.

Electrical Patents.

Issued May 20 and 27, 1890.

428,066. Arc Lamp. Charles P. Breese, New York, N. Y.

428,071. Insulator for Electric Railway Wires. Harold P. Brown, New York, N. Y.

428,072. Trolley System for Electric Railways. Harold P. Brown, New York, N. Y.

428,073. Commutator Brush for Dynamos. Lewis Van Brown, Asheville, N. C.

428,075. Apparatus for Detecting Waste of Water. Benjamin S. Church, New York, N. Y.

428,084. Electric Meter. Alphonse Frager, Paris, France.

428,087. Process of Electro-Deposition. Davis Garrett, Kansas City, Kan.

428,095. Electric Signal Circuit. Orlando W. Hart, Fall River, Mass.

428,098. Electric Railway. Rudolph M Hunter, Philadelphia, Pa.

428,116. Galvanic Battery. Archibald J. MacDonald, North Tiverton, R. I.

428,136. Trolley Arm Support for Electric Railways. Frank B. Rae, Detroit, Mich.

428,145 Elevated Conduit for Electric Wires. Henry N. Ruttan, Winnipeg, Manitoba, Canada

428,169. Electric Motor Regulator. Walter H. Knight, New York, N. Y.

The invention consists in providing a reversing mechanism for the motor with a stop or lock, so that it can be operated only when there is a sufficient amount of resistance inserted to prevent injury, and it, furthermore, consists in providing a stop or lock for the resistance controller or regulator of the machine, by which when the reversing mechanism is at the neutral point, the resistance cannot be cut out.

428,174. Telephone. John C. Ludwig, San Francisco Cal.

428,175. Electric Locomotive. James F. McLaughlin, Philadelphia, Pa.

428,189. Three-wire Multiple Switch Board System. Ernest P. Warner, Chicago, Ill.

428,201. Machine for Covering Wire. Frank E Davis, Boston, and John Scott, Jr., Plymouth Mass.

428,210. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

428,211. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

428,221. Synchronous Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

428,222. Multiplex Telegraph. Francis J. Patten, New York, N. Y.

428,223. Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

428,224. Synchronous Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

428,225. Synchronous Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

428,226. Synchronous Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

428,247. Magnetic Lock. William W. Fenner, Kansas City, Mo.

428,256. Magnetic Lock. John Schneider, New York, N. Y.

428,280. Electric Meter. Jacob F. Mehren, Chicago, Ill.

428,289. Armature for Dynamos, etc. Albert Schmid, Allegheny, Pa

428,290. Electric Meter. Ernst W. von Siemens, Berlin, Germany.

428,317. Regulator for Electric Current Generators. Gustav Pfannkuche, Cleveland, Ohio.

428,358. Cut-out. Nathan P. Stevens, Concord, N. H.

428,378. Electric Furnace for Melting Metals. Edward A. Colby, New Haven, Conn.

428,379. Electric Induction Device. Edward A. Colby, New Haven, Conn.

428,380. Dynamo Electric Machine or Electric Motor. Edgar Croasdale, Philadelphia, Pa.

428,401. Device for Elevating and Lowering Electric Lamps. John B. Morris and George Voll, Cincinnati, Ohio.

428,420. Voltaic Armor. Albert L. Scott, Allegheny, Pa.

428,427. Registering Attachment for Telephones. Robert J. Storey, John T. Storey, Albert E. Fox, and George J. Hill, Buffalo, N. Y.

428,433. Electric Gas Lighter. Robert T. Walton, Philadelphia, Pa.

428,435. Alternating Current Arc Lamp. George Westinghouse, Jr., Pittsburg, Pa.

The claims read:

"1. In an alternating current arc lamp, confronting electrodes having extended edges, the upper electrodes being of greater thickness than the lower.

"2. The combination, in an arc lamp, of a lower flat carbon of a given thickness and an upper flat carbon presenting an extended edge to the lower carbon, and of greater thickness than the lower carbon."

428,443. Electrical Heater. John I. Ashbaugh, Chattanooga, Tenn.

428,454. Electric Motor. William H. Chapman, Portland, Me.

428,459. Processs of Welding Metals Electrically. Charles L. Coffin, Detroit, Mich.

428,481. Electric Motor or Generator. Henry Groswith, Philadelphia, Pa.

428,482. Low Water Boiler Alarm Orange G Guss, Lima, Ohio.

428,499. Electric Railway. Jerome B. Legg and John Nile, St. Louis, Mo.

428,540. Electric Bath Brush. Robert E. Williams, Dallas, Tex.

428,545 Electric Insulator. Emery Andrews, Kennebunk, Me.

428,562. Electric Communication with Railway Trains. Thomas J. Houck, Baltimore, Md.

428,564. Electrical Cut-out. William J. Jenks, New York, N. Y.

428,574. Electrical Converter. William Stanley, Jr., Great Barrington, Mass.

The invention is composed of thin plates of soft iron and sheets of insulating material pasted or otherwise fastened to one surface thereof.

428,575. Method of Building Electrical Converters. William Stanley, Jr., Great Barrington, Mass.

Claim two is:

"The method of building electrical converters having laminated cores, which consists in first winding and forming the coils of the converters and subsequently building up the cores of laminæ around the coils by applying each of the laminæ to two different portions of the coils simultaneously."

428,576. Electric Semaphore Apparatus. Frederick Stitzel and Charles Weinedel, Louisville, Ky.

428,583. Watchman's Time Recorder. Charles E. Egan and Henry F. Gray, Columbus, Ohio.

428,586. Double Pole Switch. George H. Alton, Lynn, Mass.

428,604. Process of Manufacturing Carbons. Charles Heisler, St. Louis, Mo.

The method consists in applying the carbon to a bath of gasoline to prevent the penetration of the ordinary copper coating.

428,616. Sliding Clamp for Electric Welding Apparatus. Hermann Lemp, Lynn, Mass.

428,617. Electrical Apparatus for Welding Rings. Hermann Lemp, Lynn, Mass.

428,618. Transformer for Heavy Currents. Hermann Lemp, Lynn, Mass.

The secondary consists of a bar of copper cast in one piece with a groove adapted to receive the primary conductor.

428,619. Method of Welding Rings by Electricity. Hermann Lemp, Lynn, Mass.

During the operation of forcing the parts to be welded toward one another, the contiguous parts of the ring are brought into proper form.

428,620. Reactive Coil. Hermann Lemp and Walter S. Moody, Lynn, Mass.

428,633. Method of Measuring Electric Currents. Edwin W. Rice, Jr., Lynn, Mass.

428,647. Turn-off for Alternating-Current Circuits. Elihu Thomson, Lynn, Mass.

428,648. Casing for Induction-Coils. Elihu Thomson, Lynn, Mass.

428,649. Electric Meter. Elihu Thomson, Lynn, Mass.

428,650. Alternating Current Magnetic Device. Elihu Thomson, Lynn, Mass.

Of the seven claims we give the first:

"The combination, with an alternating inductor, of an induction modifier or retarder located to one side of the general magnetic axis, and serving to produce a compound field of alternating induction whose parts differ or are displaced in phase."

428,651. System of Electrical Distribution. Elihu Thomson, Lynn, Mass.

The invention consists in a system of distribution by alternating currents, in which compensating coils or transfer devices for alternating currents are placed between alternating supply mains, wires or circuits, and induction coils or converters of ordinary description for converting currents of high into currents of lower tension are placed with their primaries in the mains or wires leading to the various parts of the compensating coils.

428,652. Incandescent Lamp Socket. Elihu Thomson and George H. Alton, Lynn, Mass.

We give the second claim:

"An electric lamp base having a contact terminal composed of a screw-threaded bushing eyeleted in a non-conducting washer secured to the lamp collar."

428,653 Guard Wire Protector and Lightning Arrester for Electric Railways. Elihu Thomson, Lynn, Mass.

428,654. Process of Manufacturing Thin Sheets of Nitro-Cellulose, etc. Edmund N. Todd, Newark, N. J.

428,669. Electric Locomotive. Edward Dummer, Newton, Mass.

428,676. Electric Circuit Closer for Clocks. Henry C. Karr, Washington, D. C.

428,684. Method of Preparing Battery Zincs. James H. Mason, Brooklyn, N. Y.

The zincs are first heated and then immersed in a solution composed of mercury and acid, whereby the zinc is amalgamated.

428,683. Electric Low Water Alarm. John Morehead, Detroit, Mich.

428,698. Single Cord Multiple Switch-Board System. Charles E. Scribner, Chicago, Ill.

428,704. Electric Switch. Elihu Thomson, Lynn, Mass.

428,705. Regulator for Dynamo-Electric Machines. Elihu Thomson, Lynn, Mass.

The regulator consists of a motor geared to the brush carrier in combination with a counteracting device of constant effect which operates to reverse the motion of the parts when the power of the motor falls below normal.

The first claim follows:

"The combination, with the adjustable commutator for a dynamo machine, of a rotary electric motor having a constant torque for a given current traversing its coils and driven by the current from the machine, and a counteracting or retracting device of constant effect in the various positions of adjustment."

428,723. Electric Light Hanger. Clarence L. Jeffers, Manchester, N. H.

428,732. Electric Motor and Generator. Frank J. Sprague, New York, N. Y.

428,735 Brush Holder for Dynamo Electric Machines Franklin A. Weller, Lynn, Mass.

428,742. Commutator Collector or Block for Dynamo Electric Machines. Charles F. Brush, Cleveland, O.

The object of the invention is to provide a commutator current collector or block having an electrical conductivity sufficiently high to prevent it from becoming unduly heated when in use and of such form and material as will insure an extended and intimate contact with the commutator, and be capable of long continued use without renewal.

The invention consists in a commutator current collector or block consisting of carbon and metal of good electrical conductivity, intimately associated and combined together.

428,743. Commutator Collector or Block for Dynamo Electric Machines. Charles F. Brush, Cleveland, O.

Claim five is:

"A commutator current collector or block consisting of graphite and finely divided copper"

428,745. Electric Cable. Willard L. Candee, Brooklyn, N. Y.

428,746. Galvanometer. Arthur E. Colgate, New York, N. Y.

428,748. Device for Maintaining Electrical Connection between Separate Railway Trains. Donophan M. Fike and Joseph Huffman, Des Moines, Ia.

428,750. Coin-Actuated Attachment for Phonographs. Louis Glass and William S. Arnold, San Francisco, Cal.

428 751. Coin-Actuating Attachment for Phonographs. Louis Glass and William S. Arnold, San Francisco, Cal.

428,774. Burglar Alarm. Edwin Hayward, Brooklyn, and Edward S. Sims, New York, N. Y.

428,781. Galvanic Battery. John S. Nowotny, Cincinnati, O.

428,782. Electric Motor or Dynamo Electric Machine. Stephen M. Potter and Harry E. Morgan, Philadelphia, Pa.

428,818. Attachment for Telephone Desks. Berthold Schram, Milwaukee, Wis.

428,828. Coin-Released Telephone Lock. Harry L. Cassard, Baltimore, Md.

428,854. Electric Programme Clock. John L. McCaskey, Waynesborough, Pa.

428,888. Solution for Galvanic Batteries. Edward M. Burt, Paris, Ill.

The invention consists of an exciting solution formed of carbonate of potash and other soluble salts derived from the ash of the Indian-corn cob.

428 900. Register for Gas Meters. Leo Ehrlich, St. Louis, Mo.

428,917. Electrically Propelled Vehicle. Arnold A. Ingraham, New York, N. Y.

428,929. Suspension Hanger for Electric Lamps. Elmer P. Morris, Cincinnati, O.

428,930. Suspension for Trolley Wires. Elmer P. Morris, Cincinnati, O.

428,934. Electric Switch. James F. McLaughlin, Philadelphia, Pa.

428,935. Electric Switch. James F. McLaughlin, Philadelphia, Pa.

428,942 Holder for Electric Arc Lamps. Jacob Pawlowski, Cincinnati, O.

428,970. System of Circuits for Electric Semaphores. Frederick Stitzel, Louisville, Ky.

428,979. Electric Insulator. George B. Watson, Boston, Mass.

428,989. Globe for Electric Lamps. William H. Wilson, New York, N. Y.

429,012. Magnetic Tool. Charles F. Carpenter, Louisville, Ky.

429,033. Watch Demagnetizer. Ferdinand F. Ide, Peoria, Ill.

429,049. Process of Assembling Secondary Battery Electrodes. James F. McLaughlin, Philadelphia, Pa.

429,058. Device for Suspending Electric Conductors. Homer J Pierce, Lynn, Mass.

429,067. Support for Electric Lights and Conductors. Charles H. Simmons, Brooklyn, N. Y.

429,074. Staff Apparatus for Controlling Traffic on Single Line Railways Francis W. Webb and Arthur M. Thompson, Crewe, County of Chester, England.

429,093. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

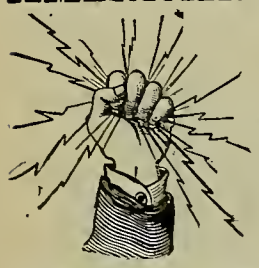
The object of the invention is to supply current to electrically propelled vehicles from one or more suspended conductors extending along a railway, be they elevated above the vehicle, on a level with the roof of the vehicle, or under the vehicle.

429,094. Electric Motor. Rudolph M. Hunter, Philadelphia, Pa.

429,104. Underground Conduit for Electric Wires. Erich L. Witthaus, Baltimore, Md.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



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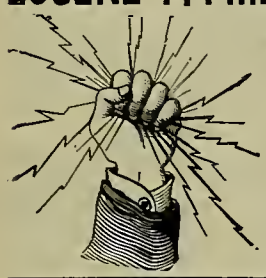

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THE "CLARK" WIRE.

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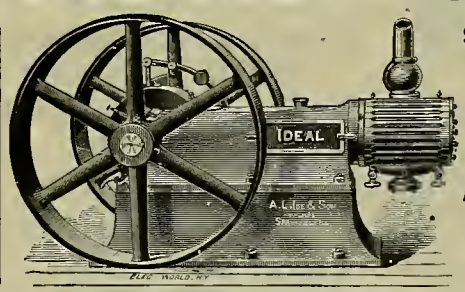

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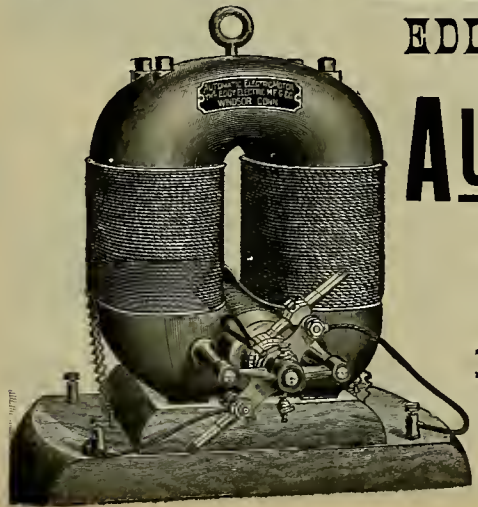

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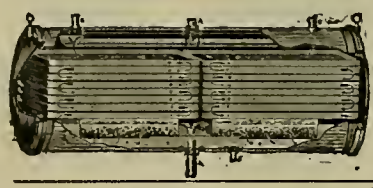

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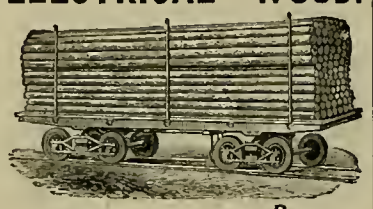

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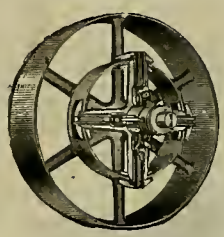

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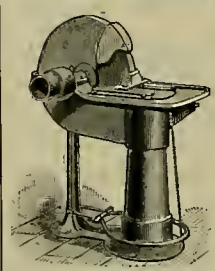

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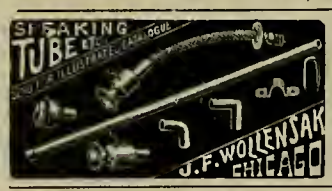

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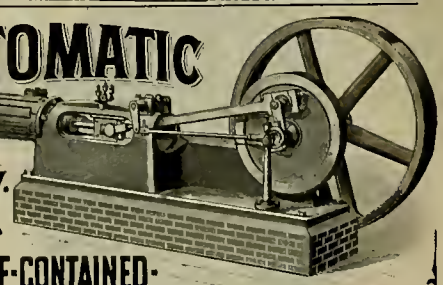

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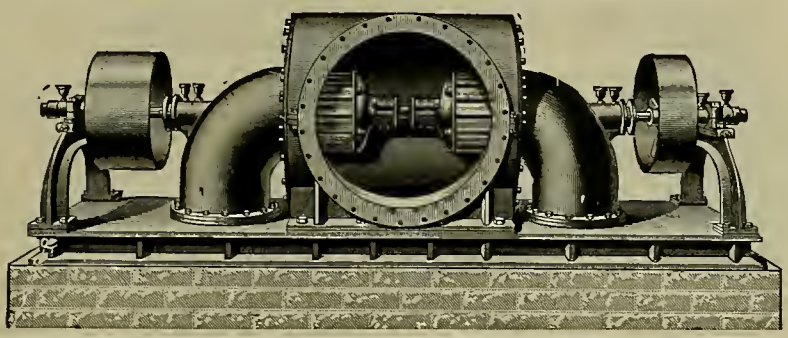

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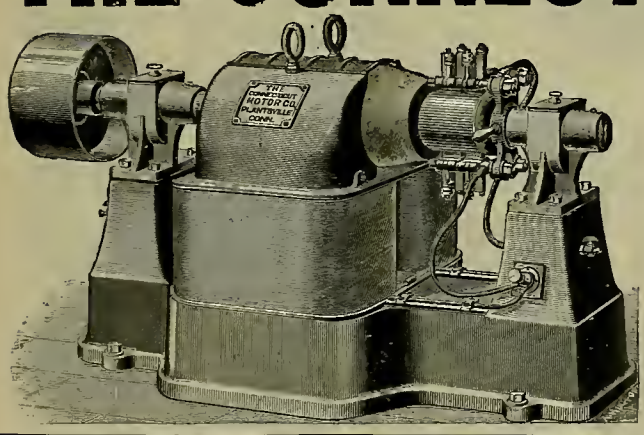

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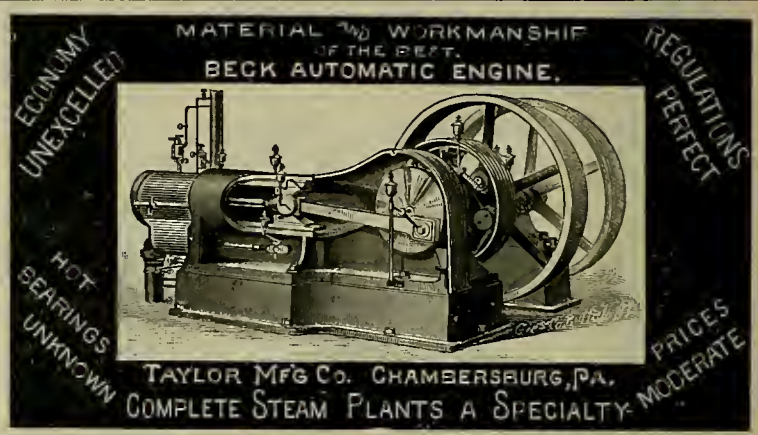

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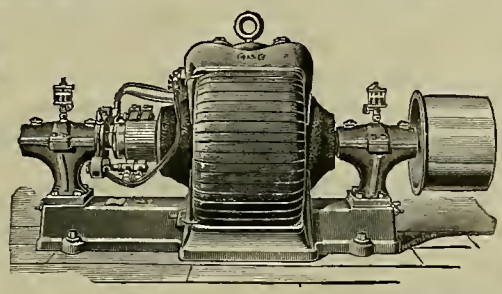

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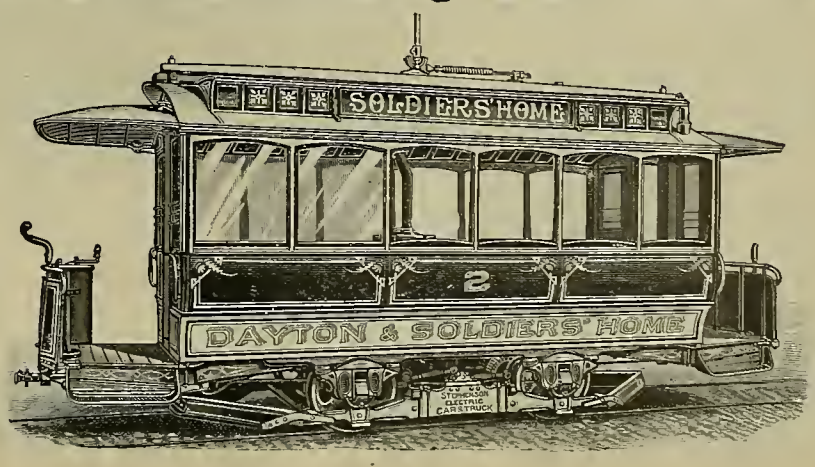

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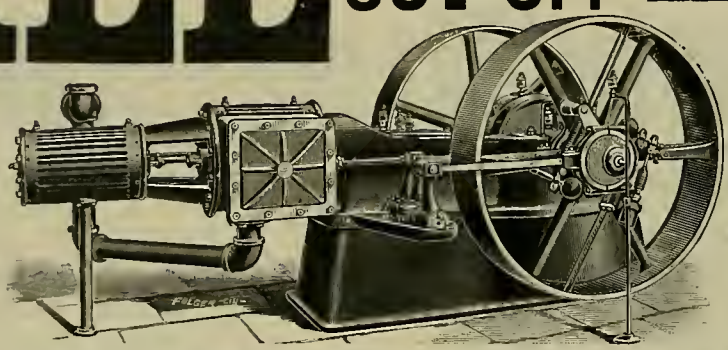

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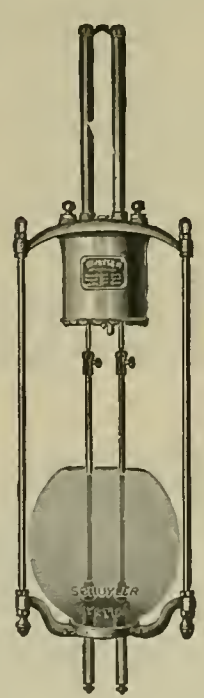

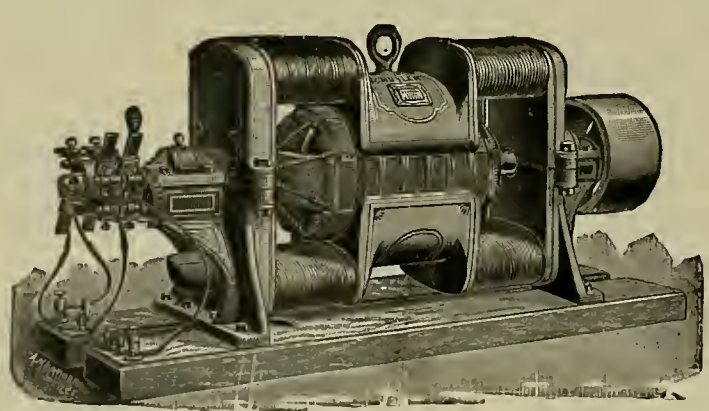

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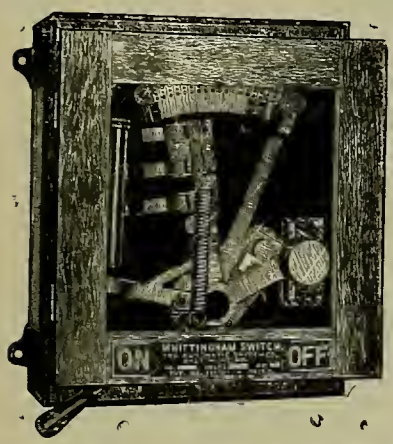

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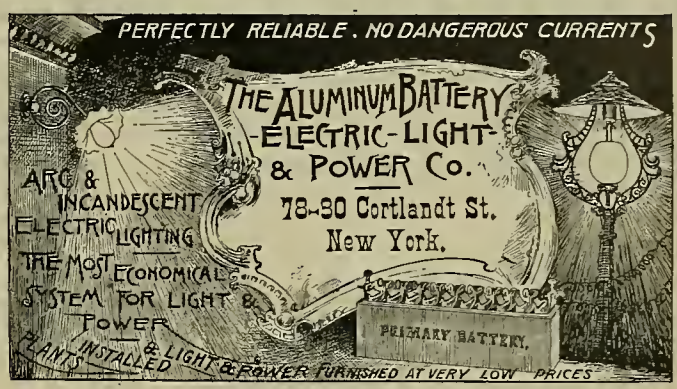

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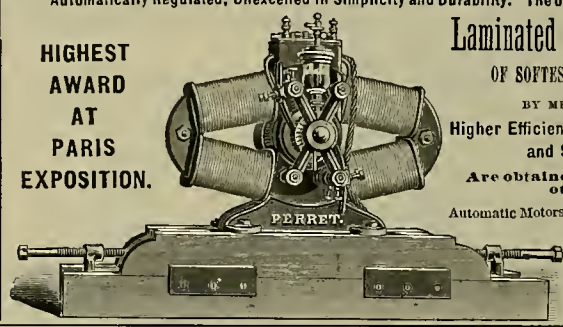

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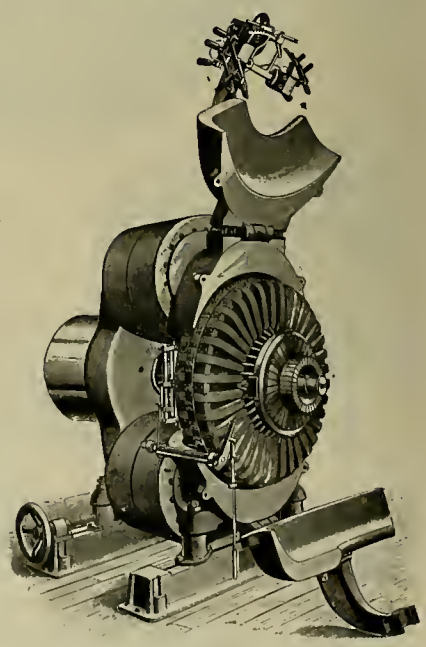

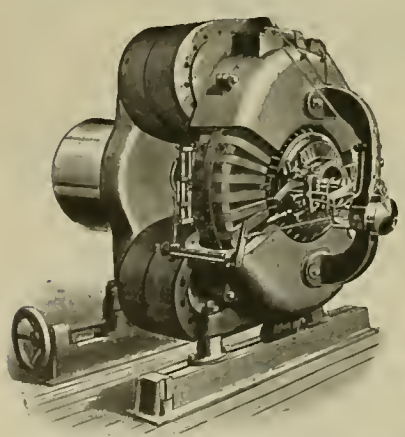

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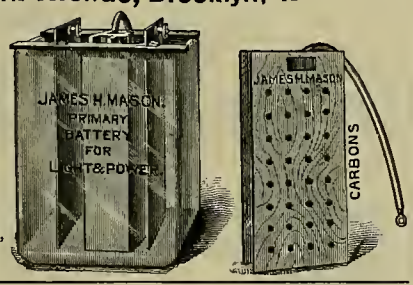

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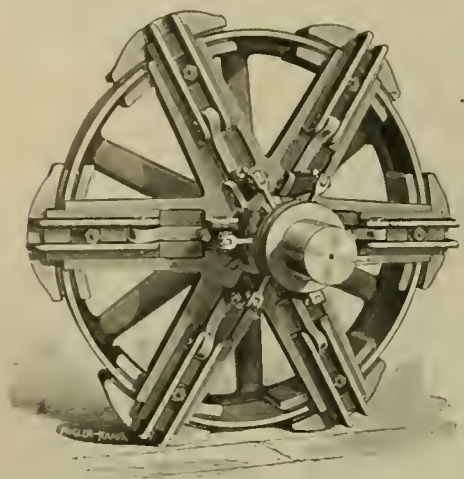

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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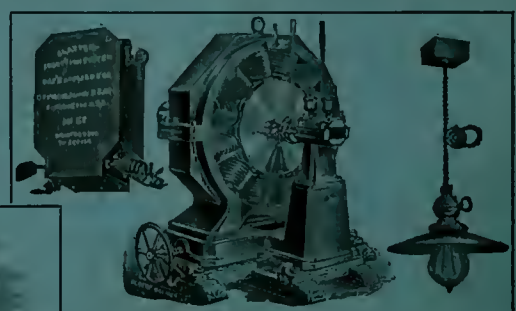

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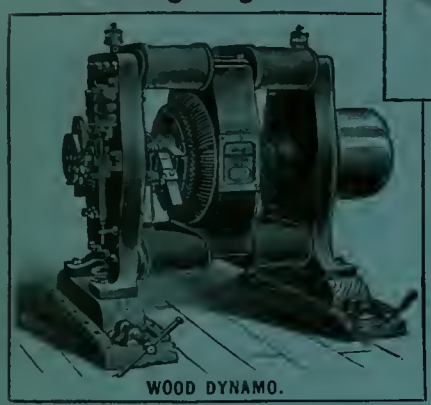

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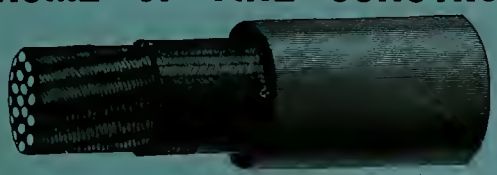

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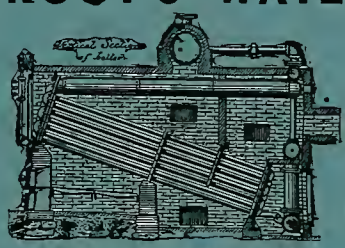

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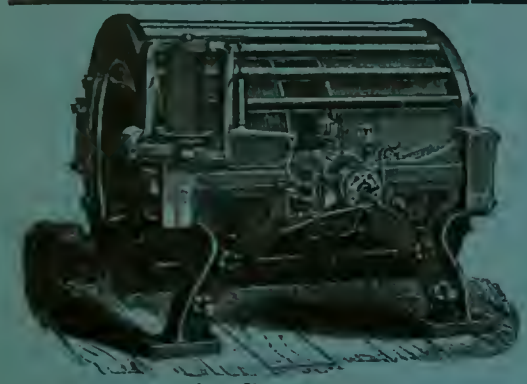

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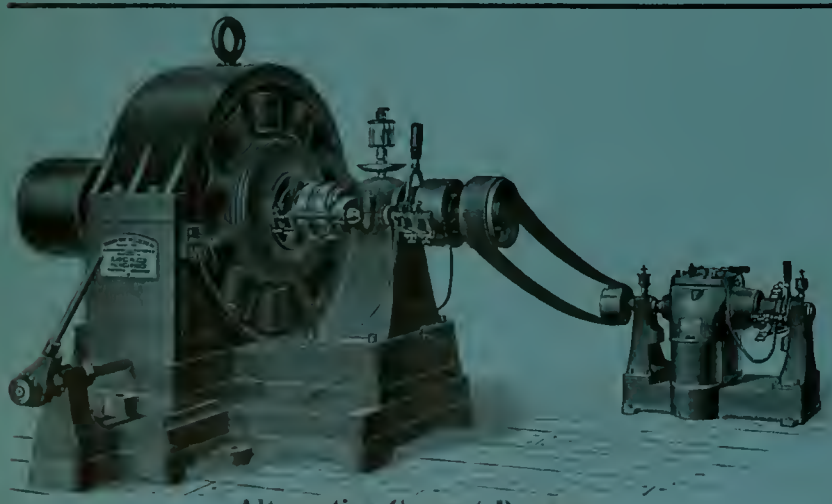

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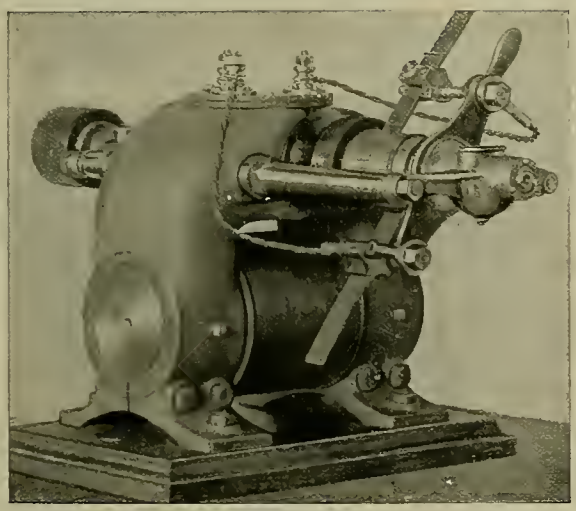

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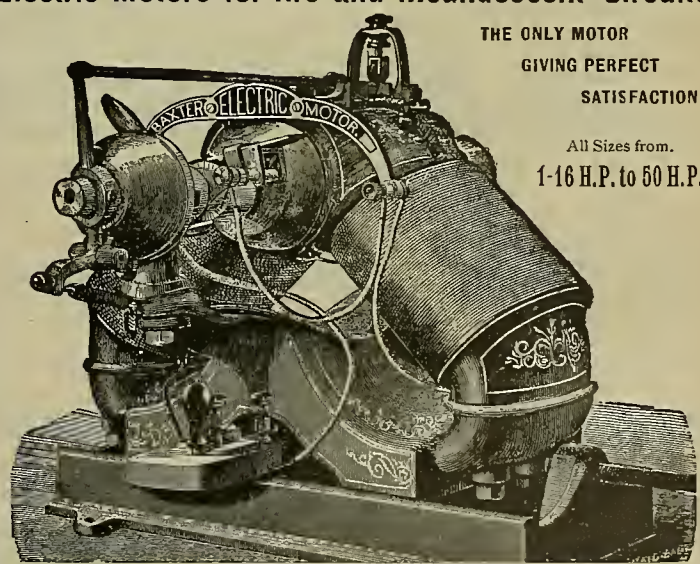

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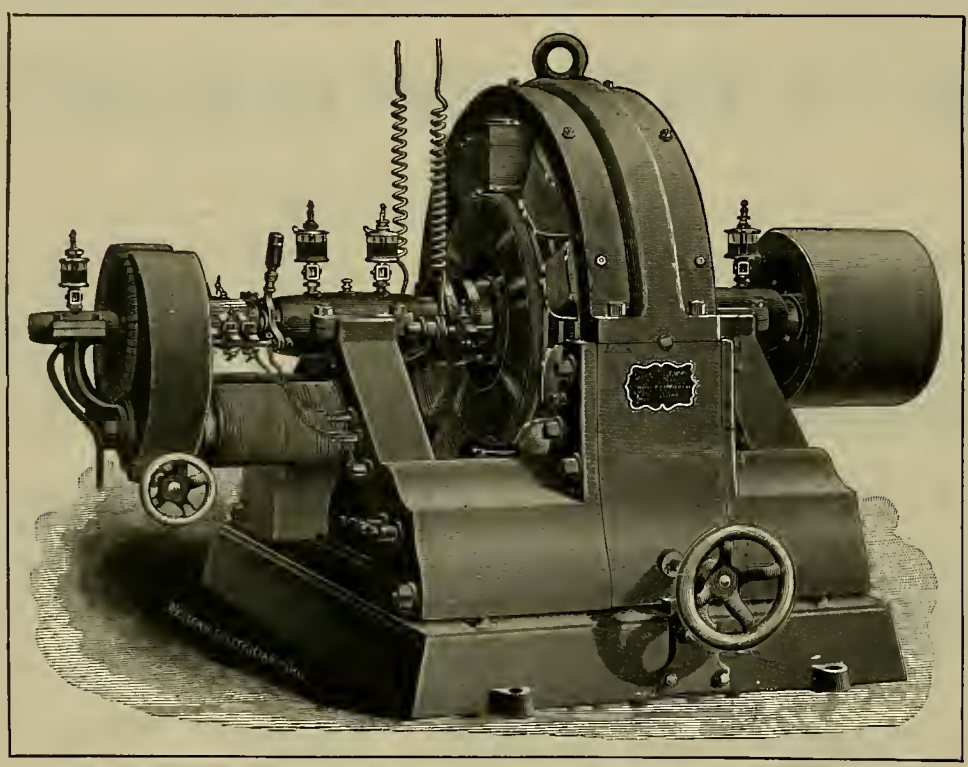

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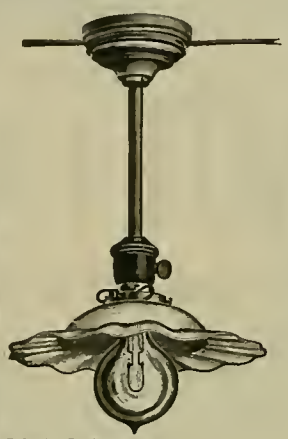

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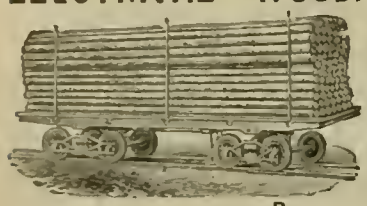

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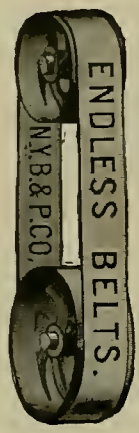

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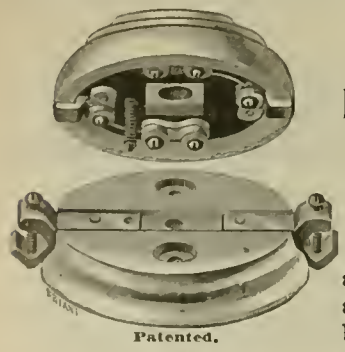

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Vol. VI. CHICAGO, JUNE 14, 1890. No. 24

Chicago City Electric Light Plant

The new West side station of the Chicago city electric light system on Throop street is the largest plant in the municipal street lighting system, and one of the most complete and attractive stations in the country. This plant is in the territory first lighted by the city from the Jefferson street station, and since its completion the old power house has been abandoned. The accompanying cuts give two excellent views of the dynamo room. In Fig. 1 is shown one portion of the room and part of the switch-board, while Fig. 2 represents the other half of the room. At present there are 20 dynamos of the Western Electric company's make in this station. Each machine has a capacity of 35 lights. It is the intention of the administration to increase the plant to 1,000 lights' capacity as soon as the city's finances will permit the purchase of additional apparatus. There is plenty of room for the additional machinery, the station having been constructed with the idea that the present demand would be doubled in a very few years.

The new power house is located on the west side of Throop street, just south of Van Buren. It is a substantial two-story brick structure of the same dimensions as the North side plant, recently described in these columns. On the ground floor are the engines, and on the floor above, the dynamos. In the rear of this building is the boiler room, and behind this the coal house and storerooms, etc. Everything about the station is conveniently arranged, and under the excellent management of Frank Flynn, the station presents a neat and attractive appearance.

The arrangement of the dynamos is clearly shown in the illustrations. They are belted direct to the engines on the floor below, and by means of an adjustment of the carriage of each machine, the belt may be tightened when necessary. The machines have given the most satisfactory results, and City Electrician Barrett is well pleased with the plant.

The engine room on the first floor contains 5 Ideal engines of 125 horse power each, manufactured by A. L. Ide & Son, Springfield, Ill. This type of engine was illustrated in this paper May 10th.

There are 13 circuits connected with this station, comprising 75 miles of underground cable—Patterson, Standard, Okonite, Kerite and Cobb Vulcanite being included in the system. On these circuits there are 354 lights at the present time. These include all the South side electric lights and the river lights, with the exception of a few on the North side, which are connected to the North side station. The lights are distributed on the following streets: Throop street from Harrison to Madison, Harrison from Throop to the river, Madison from Michigan avenue to Western avenue, Washington, on the West side from Desplaines to the river, and on the South side from Market to La Salle, Van Buren from Fifth avenue to Halsted, Michigan avenue from the river to Jackson street, Randolph from the river to Franklin street, Canal from Randolph to Van Buren, Desplaines from Randolph to Harrison, Halsted from Madison to Harrison, Milwaukee avenue from Harrison to Sixteenth street.

It will be seen that the streets now lighted by electricity from this station, form what might be called a skeleton, which in a few years will be filled out, comprising a most complete system for lighting the whole territory included. As soon as the South side station is completed, the streets now supplied with light from the West side station will be cut into the South side plant.

The enlargement of the West side plant is especially noteworthy, as it furnishes substantial proof of the success of the underground system of street lighting which has attracted so much attention to Chicago. When the city started its first underground plant for street lighting on Christmas, 1888, there were not a few who entertained honest convictions that the system could only end in failure. The splendid results thus far achieved, however, encourage the belief that the project will stand the test of time and bear witness to the wisdom of the projectors of the enterprise. To Prof. Barrett, the city electrician, and his faithful assistants, the acknowledgment of the success of the undertaking is the best reward they can desire. They are to be congratulated upon the result of their labor.

The South side station will be built this year at the corner of Fourteenth street and Indiana avenue. The lot secured by the city at this point is 161 feet long and 44½ feet wide. This

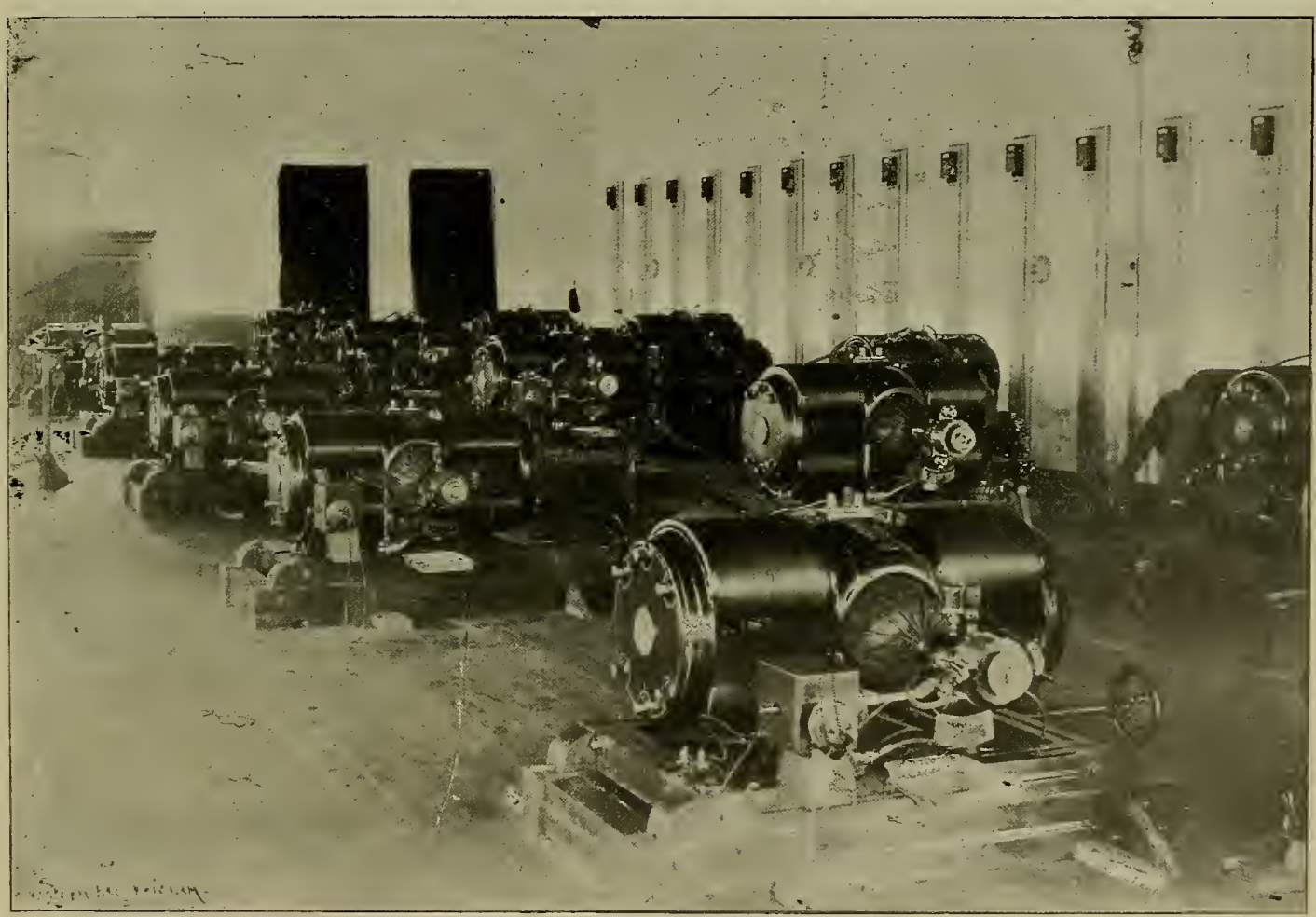


FIG. 1. CHICAGO CITY ELECTRIC LIGHT PLANT—DYNAMO ROOM, THROOP STREET STATION.

will make it necessary to change the style of the house somewhat from the original design, and plans have accordingly been prepared to meet the new requirements. The new station will be about 8 feet narrower than those on the north and west sides of the river. Some trouble was experienced in the other stations through vibration, and extra precautions will be taken to guard against this in the new power house. The station proper will be a two story brick structure faced with Indiana brick. The lower walls will be 17 inches thick, while the upper will be 13 inches. A slate roof, supported on iron trusses will cover the structure, while a corrugated iron roof on iron trusses will be employed in the boiler house—a one story structure attached to the engine and dynamo house. The engines will be arranged on the ground floor. They will be larger than those now in use in the present city plants. The old 225-horse power Wright engine at the Jefferson street plant will be removed to the South side station, and there will be two more, each of 200-horse power. Directly above the engines is the dynamo room. The floor of this room will be supported by two rows of 12 inch posts of Georgia pine, resting on piers 3 feet square. On these posts rest 14x14 inch timbers supporting 8x12 white pine timbers, 4 feet apart. The flooring is laid on this and it is 4 inch white pine, matched and dressed. The arrangement of the dynamos and engines is shown in Fig. 3 which also gives an excellent idea of the general manner of belting adopted in the city plants. Back of the dynamo and engine house is the boiler room in which there will be six boilers of a capacity of 840-horse power. These boilers will be 72 inches in diameter and 18 feet long.

It is now proposed to install 16 dynamos each of a capacity of 60 lights. This will give the South side the largest plant in the city service. When the plant is completed the lamps on the South side now fed from the West side station will be cut into the South side plant.

The cut representing the sectional view of the South Side station is a photographic reproduction of the official tracings on file in the city engineer's office, Chicago, where contractors, desiring to present bids for the work, may see the plans and secure specifications.

The Lincoln street power house has been brought into service though all the machinery has not yet been installed. Brush machines are used.

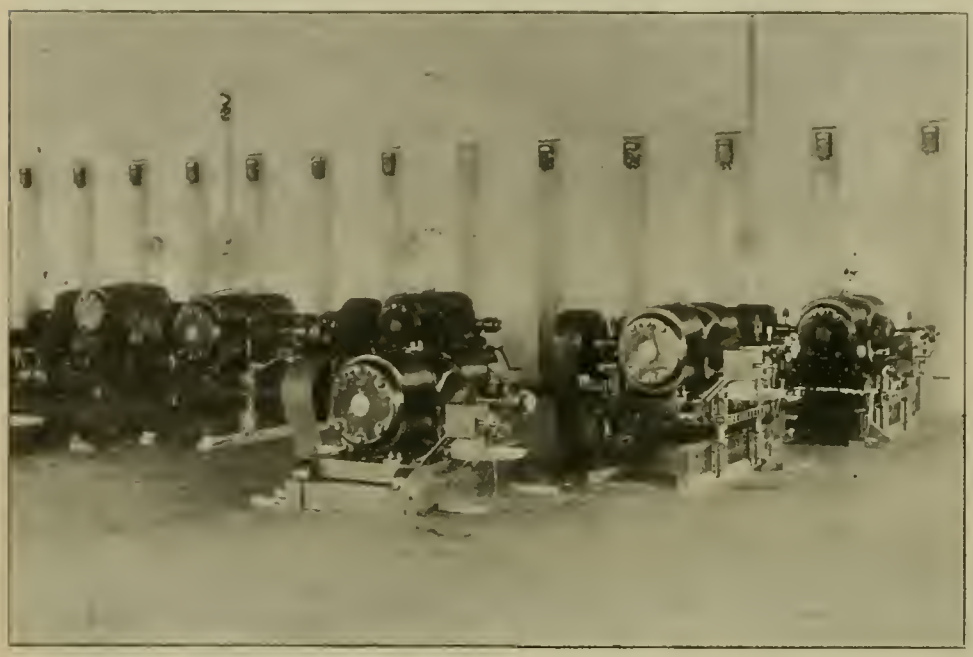


FIG. 2. CHICAGO CITY ELECTRIC LIGHT PLANT—DYNAMO ROOM, THROOP STREET STATION.

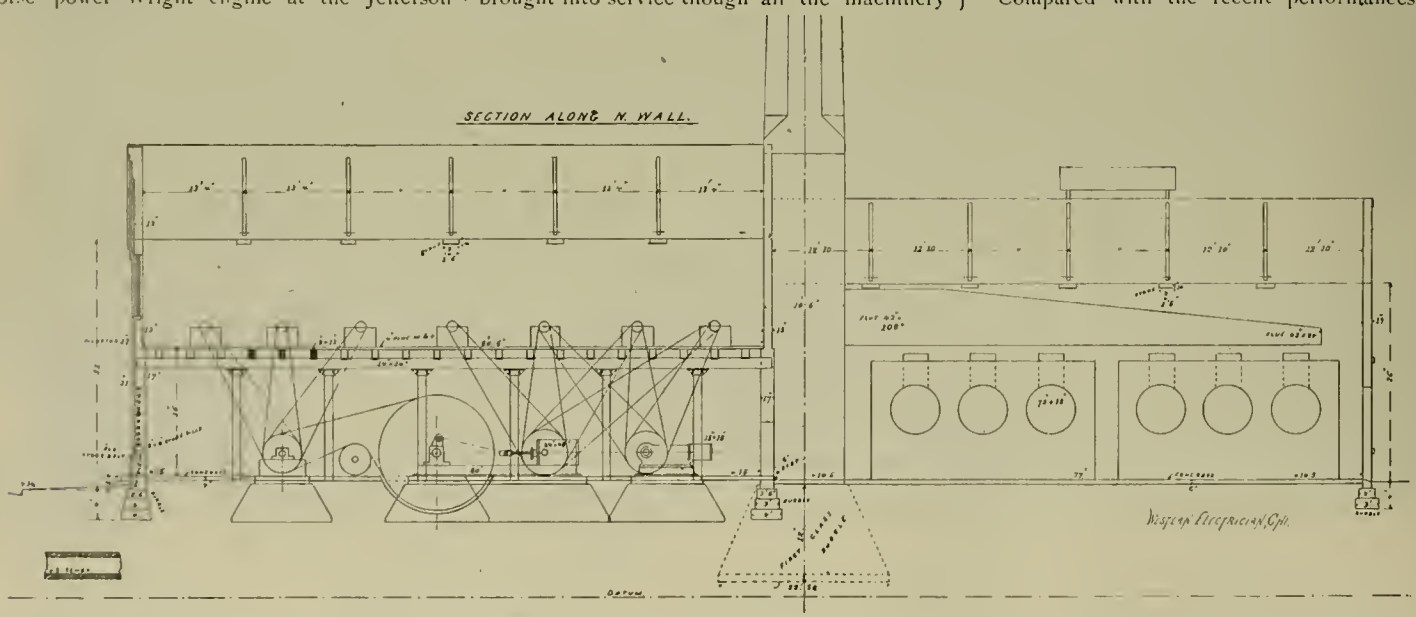


FIG. 3. CHICAGO CITY ELECTRIC LIGHT PLANT—SOUTH-SIDE STATION.

Chicago Electric Club.

A special meeting of the Chicago Electric club was held Monday evening, June 9th, Vice-president Badt presiding. The secretary read the report of the board of managers on the question of making arrangements with Kinsley for continuing the restaurant service. After a thorough discussion the board was authorized to make the arrangements suggested in the report. Alex. Kempt was unanimously chosen chairman of the house committee. It was further agreed to close the season with an appropriate entertainment and banquet, and the question was referred to the banquet committee composed of Fred Degenhardt, F. S. Terry, W. J. Buckley, W. A. Kreidler and Alex. Kempt. The banquet will be held the last of this month.

Telegraph Tournament at St. Louis.

The first western tournament of fast sending telegraphers was held at St. Louis June 8th, and proved highly successful. The attendance was large and the exhibitions highly creditable. Numerous instruments were arranged about the hall, so that every telegrapher in the "audience" could understand the transactions. C. P. Higgins of the Western Union, acted as time-keeper. The results were announced as follows:

Class A, first section—Highest readable speed. First prize $50, J. M. McAndrew, Postal Telegraph company, 226 words; A. T. Ellis same company, second, $30, 224 words; J. C. McIlvaine, Western Union, third, $20, 221 words.

Class A, second section—For highest speed combined with the most perfect Morse: A. T. Ellis, Postal, first, $25, 224 words; T. M. Eckert, Western Union, second, $15, 212 words; F. C. Ritchie, Associated Press, third $10, 210 words.

Class B (for ladies)—Highest readable speed: First prize, $25, Miss Mollie Landrigan, Postal, 206 words; second, $15, Miss Katie Higgins, Western Union, 202 words; Mrs. F. I. Potter, Western Union, third, 191 words

Class C (old-timers who were in the telegraph service prior to 1865)—Highest readable speed: C. E. Turner, first, $25, 199 words; M. D. Crain, second, $15, 197 words; James W. Cook, third, $10, 179 words.

There was considerable good-natured rivalry between the employes of the Western Union and Postal companies, which served to arouse additional interest not only in the operators, but also among the officers of the company, as each was desirous of making a fine record. In the number of prizes honors were equally divided. The Postal, it will be seen, carried off the first prizes in Class A, both for fast sending and best Morse, combined with highest speed, and that company's representative in the ladies' class led her fair competitors in a close and exciting race. The Postal secured second prize in Class A also. This is an unusually good showing. Both companies may well feel sstisfied.

Compared with the recent performances in New York city, the western "cracks" made a good showing, though their exhibition was not up to the standard set by Pollock, who surprised the world by his marvelous sending, and then retired to the woods. The New Yorkers could not approach this young man's record, and many of them fell far below the St. Louis standard. Miss Kittie B. Stephenson retains her position at the head of the lady operators of the country, her record at the recent New York performance being unsurpassed.

Phonograph Convention.

In the last number of the WESTERN ELECTRICIAN was printed a report of the recent convention of representatives of phonograph companies in Chicago. The accompanying illustration is reproduced from a photograph taken during one of the sessions of the convention. The reporter of the proceedings, who is seen at the phonograph table at the right of the picture, was photographed in the act of talking his report of the meeting into his instrument. A reference to the advantages claimed for the phonograph method of reporting meetings was given in connection with the account of the phonograph convention last week. Jesse H. Lippincott, who controls the North American Phonograph, Co. stands at the right of the reporter in the group. At his right behind the table stands President Clancy.

THE PHONOGRAPH CONVENTION.

Opposed to Electrocution.

The New York *World's* foreign correspondents have been interviewing scientists on the other side of the water in regard to execution by the application of electricity. Dr. D'Arsonval of Paris expressed his objections to electrocution in the following terms:

"I am entirely opposed to the plan of execution by electricity," he said. "I consider it impractical, illogical, and, above all, uncertain, and this is the opinion of every one of my confreres with whom I have spoken on the subject. I do not deny that death can be produced by these appliances, but not definitely in every case. The only cases in which I have been able to produce death irrevocably have been where I have laid bare the spinal cord and directly applied the current to the naked mass. Of course it will not be practicable for the executioner to do that, for that would be downright torture, and it would be infinitely simpler for him just to thrust into the spinal cord the knife with which he laid it bare. That would have exactly the same effect as the electric current, namely, that of disorganizing the nerve tissues so completely as to cause death. Say I have electrified two big dogs. I leave one alone and begin to practice artificial respiration on the other. In a very few minutes the latter is as well as if he had been uncertain. That is the opinion of us all. Dr. Brown-Sequard only a day or two ago said: 'It is scandalous that an unknown agent should be used for such a purpose.' The responsibility of the men who passed that bill and that of those who will carry out its provisions is a terrible one."

Dr. De Boer, editor of *Electricité*, said his great objection to electrocution was to be found in the fact that it was "too beautiful to be subjugated to such work as that." He continued:

"We have frequently talked about it in the office and I have not heard one man express himself in favor of the innovation. The principal objection that I have heard against it, apart from the sentimental one, is that it cannot be stated positively that this machine is absolutely certain. M. Joubert, who was in here a few days ago, said that in three cases out of five in which he had experimented on animals with the lethal apparatus, similar, so far as he could judge, to the one that is in readiness for Kemmler's execution, the current had to be twice delivered before producing the desired effect. What was a matter of little importance with rabbits as victims, becomes naturally of very serious importance indeed when the life of a human being is in question. We understand over here that in America it was considered that death inflicted by electricity would be much less painful than that of the gallows. I am not at all certain of the correctness of this opinion. I imagine that the passage of the current through the body of the condemned man would produce hellish torture. It is contended, I am aware, that death will be so rapid that the victim will feel nothing; but this argument is urged by people who ignore the truth that to the man in the expectation of death time is infinitely longer than under ordinary circumstances. One second to the man under the knife of the guillotine is a long period of suffering—a fact which is known to every physiologist who has studied the question. It is, therefore, nonsense, to say that death will be so quick as to be painless."

Maxime Cornu, of the College of France, said that while he greatly admired the inventiveness of Americans, he could not congratulate them on this last departure. He said:

"Science has nothing to do with the shambles. If the death penalty has to be inflicted the old methods are decidedly preferable. I have not heard a single confrere of mine express a contrary opinion. We look upon this as a costly farce. I am aware that some people contend that it is done from a merciful feeling, that it has been invented expressly in order to accelerate the death of the condemned man; but surely the guillotine, the gallows and the garotte effect their purpose admirably. After all, the death penalty is a punishment, and I ask why should its penalty be diminished when at the same time a great danger is incurred that the condemned man may be unnecessarily tortured?

M. Joubert expressed his objections to electrocution in this way:

"When I first took up the study of electricity I was well aware that its aid would be required for a very large number of things, but that of execution by electric shock hardly occurred to me. Now, this is a subject into which not only a lot of sentiment enters, but also, I think, a strange kind of conservatism. We get attached, as it were, to certain ways of putting a criminal to death, and once that attachment—excuse the prostitution of the word—is formed, one does not care for any new-fangled idea. In many countries hanging is considered the acme of excellence as capital punishment, while we Frenchmen have grown accustomed to the guillotine."

The opinion of Dr. Werner von Siemens was decidedly different.

"What queer people you Americans are," said the professor. "Why are you not content to hang your criminals or behead them?"

"Because," was the answer, "some people in America think that killing by electricity is more humane than hanging. Others say that it would be cruel torture. What do you think about it?"

"It is nonsense to talk about torture," said the professor, "if the work was thoroughly done. Let a practical

electrician make his preparations carefully and the man will die as easily as though he were struck by lightning. The latter, you know, is a painless form of death. It all depends upon the way the thing is done. There is no pain about the guillotine. The man who is executed does not feel the knife. There is no pain in hanging if you manage to break the victim's neck. There is less pain in electricity if you apply it properly and use enough power."

"How strong a current do you think is needed to kill surely and swiftly?"

"Five thousand volts at least, I should say. Nothing less than that will do."

Herr von Helmholz spoke in the following strain:

"Granted that all your preparations are perfect, that the electric charge is powerful enough and that it comes like a stroke of lightning, death will be swift and painless. But if the shock is not lightning-like the victim may die a most painful death. Unless you kill your man instantly tetanus will set in and he will die in dreadful convulsions. He will be choked to death, in fact, in a manner ten times worse than when launched from the gallows. I should scarcely think that a dynamo would answer the purpose. It cannot

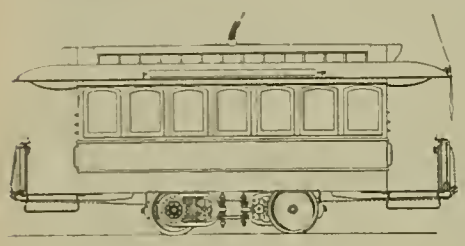


FIG. 1. NOVEL CLUTCH.

accumulate force enough to strike like lightning. You would need a powerful storage battery—one such as the late Warren de la Rue, of London, constructed, which is 80 yards square. Accumulate the electricity from that and then discharge the whole of it at once. Then you may rely upon killing your man. I should think that nothing less than 5,000 or 6,000 volts discharged at once would lead to immediate death. The cruelty of a death sentence lies not in its execution but in the anticipation of it. But, after all, why take a new and untried method? The gallows, the guillotine or the axe, all are merciful and comparatively painless. If you want to take the easiest means knock the man on the head."

"Knock him on the head! Is that not very brutal?"

"It sounds so; but in reality, if the blow is delivered with enough force, death is perfectly painless."

J. Z. de Ferranti, of the London Electric Supply corporation, stated that he was decidedly opposed to electrical execution.

Novel Clutch.

The cuts presented herewith represent diagrammatically an ingenious apparatus, which has recently been invented by W. D. MacQuesten of New York. The invention might be described as a magnetic clutch. It was designed more particularly to be used in connection with the electric street car, where it is advantageous to have the motor run continuously, so that the car may be easily started with a minimum amount of current.

Fig. 1 shows the general arrangement of the device when applied to an ordinary electric car. Fig. 2 represents the clutch more in detail, and Fig. 3 is a section of Fig. 2.

Referring to the cuts it will be seen that the car is provided with two motors. These motors are connected in the usual manner, except that the large gear *W* runs loose on the axle. Within this wheel is placed the magnetic clutch. A

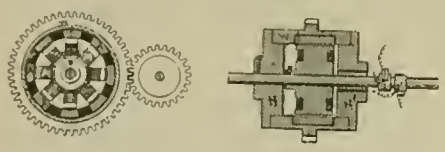


FIG 2. NOVEL CLUTCH. FIG. 3.

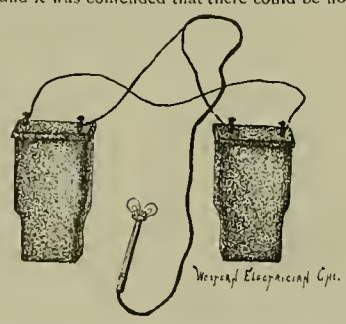
close inspection of Figs. 2 and 3 will show that the clutch is made up of a series of electro-magnets *M*, forming part of a common hub securely fastened on the axle. Each magnet has co-operating with it an armature *A* forming part of the gear wheel. These armatures extend around the inner periphery of the gear, and are magnetically separated from each other. The wheel itself is supported, as indicated in the section, Fig. 3, by two cylindrical hubs, *H* and *H'*, fastened on the axle.

The operation of the device will now be readily understood. When it is desired to start the car with the motor running at full speed, current is switched into the coils in the clutch. This energizes the cores, and as the armatures *A* are fixed on the revolving gear *W*, the magnetized hub will tend to follow the revolving gear wheel. As a result the car-axle will be revolved slowly at first, but more rapidly as the magnetic attraction gradually increases, until in the revolution of the car-axle the relative position of each magnet, and its armature becomes unchanged—that is, the gear wheel and the armature are revolving at the same speed.

Electric Light and Bogus Spiritualists.

Every day seems to bring to light some new and ingenious application of the electric lamp. In a recent issue the New York *World* published an interesting story of the manner in which a noted bogus spiritualist of Brooklyn was exposed. The medium, a Mrs. Cadwell, was apparently one of the shrewdest of her kind and it was only through the aid of the storage battery and incandescent lamps that the exposure was made completely successful. Two small storage cells of such size that each could be conveniently carried in a man's hip pockets were secured by the reporters and were connected as shown, by flexible cables, to a small handle carrying a couple of 5 candle power incandescent lamps. Two sets similar to the one described were provided, and on the day fixed upon for the grand exposure two reporters equipped themselves each with one of the electric torches, and with batteries, wires, etc., well concealed in their clothing, sallied forth to mingle with the crowd of "believers" at Mrs. Cadwell's. Without going into the details of the seance it will suffice to say that the reporters waited only long enough to see that all was in full blast and then commenced action. What followed may be better described in the words of a prime mover in the plot:

Mrs. Cadwell is a large, tall woman. The spirit so boldly advancing into the room was apparently small and slight, and it was contended that there could be no decep-



ELECTRIC LIGHT AND BOGUS SPRITUALISTS—LAMPS AND POCKET STORAGE BATTERIES.

tion about this. There were expressions of astonishment. Then some one invited any one who wished to do so to advance and look into the spirit's face.

"Now's your time!" the writer hastily drew his electric light from his sleeve and cleared away the wire ready to turn the switch and close the circuit.

It was a trying moment Were the connections all right? Had not the trip up to the elevated disarranged the wires? Would the current do its work? To fail now was to court physical injury. All these questions presented themselves with the rapidity of lightning. There was no time for delay. The word had been given to act and already the woman reporter had advanced to the side of the spirit. Others had gathered around her.

"Well! well!" was the expression of the writer, as if surprise had overcome him, but it was the signal which told the artist that the reporter was going to the cabinet and that it was his time to act.

He was on his feet in an instant. At the same moment the reporter, who had advanced to the cabinet, was seized violently by Delerce on one side and Mrs. Richardson on the other.

"Keep out of the cabinet!" they both shouted.

It was the work of an instant to grapple the two, who were bent upon protecting the cabinet.

Suddenly the reporter shouted, "Wonderful! wonderful!!" the signal which was to send the artist to the cabinet. He understood it immediately and a second later he had taken the guards on their flank as they struggled with the reporter and signalized his victory by shouting:

"There's nobody in the cabinet but me!"

Simultaneously both lights were flashed. The electric current did its work grandly. The reporter had flung the two confederates from him and his light illuminated the quaking form of the spirit.

It was Mrs. Cadwell. From the cabinet the light held by the artist shot out its scintillant rays, illuminating every crevice. He was master of the situation. The utmost confusion reigned. Some of the women shrieked, and ran from the room.

Arrangements have been about completed for building a motor street railway system in Beatrice, Neb. The enterprise is backed by abundant capital, and it is authoritatively stated that the line will be in active operation within sixty days.

Kammeyer Fuse Box.

Practical men who have had charge of incandescent circuits will appreciate the advantages claimed for the fixture illustrated in the accompanying cut.

This fuse box is the invention of C. E. Kammeyer, superintendent of the National Electric Manufacturing company, Eau Claire, Wis. It was designed with the object of reducing the danger attendant upon the insertion of safety fuses in live circuits.

The cuts represent two forms of the device. Fig. 1 shows a form of fuse box adapted for service in the primary and secondary circuits of an alternating current system. A glance at the illustrations will enable the reader to understand

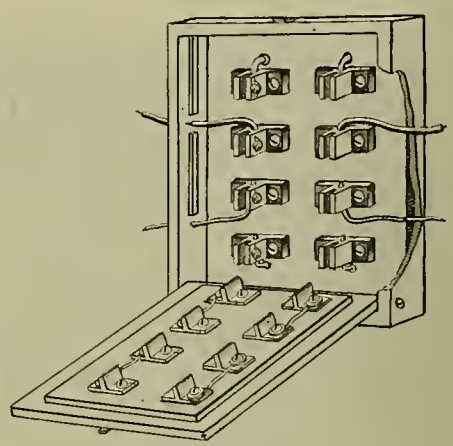


FIG. 1. KAMMEYER FUSE BOX.

the peculiar feature of the invention. By constructing the box, as shown, with the binding posts for the fuses attached to the lid, a strip may be inserted with but little trouble and without the slightest danger of a shock, or a short circuit.

Fig. 2 represents a modified form of box in which the lid is made so as to slide into place instead of being hinged, as shown in Fig. 1.

Impending Patent Legislation.

Editor WESTERN ELECTRICIAN:

Attention of inventors and the general public is invited through your widely circulated paper to what many will consider the vexatious and unnecessary section 13 in H. R. bill 10,637 now before Congress. This section is in the words following:

Sec 13. That, within five years from and after the date of issue of each patent for an invention or discovery hereafter granted, some person interested in or under the same shall pay a tax of TEN DOLLARS upon the same to the commissioner of patents, or such patent shall terminate and expire at the end of such five years. Within ten years from and after the date of issue of each patent for an invention or discovery hereafter granted, some person interested in or under the same shall pay an additional tax of TWENTY-FIVE DOLLARS upon the same to the commissioner of patents, or such patent shall terminate and expire at the end of ten years.

This provision renews the attempt made some twelve years ago to levy a like impost on the creators of conveniences. Strong reasons both of right and expediency were then urged against the measure, and the bill (or rather bills, for there were two of them, one in the house and another in the senate)—notwithstanding some good clauses—failed to become a law. In like manner the good features of the present bill are, in the opinion of many, handicapped

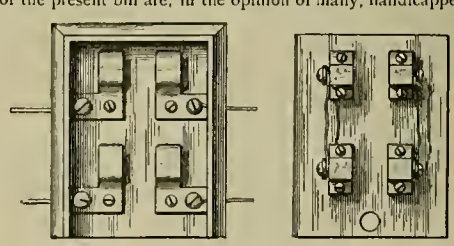


FIG. 2. KAMMEYER FUSE BOX. FIG. 3,

by the section in question. To discuss all the arguments *pro et con* would take up more space than the writer has present time to give, or you might care to accord. A few only of the many considerations bearing on the subject must suffice.

1. There is nothing in the constitutional clause (Art. 1, Sec. 8) on which our patent legislation is predicated, which gives ground for the belief that its framers contemplated such grants being made a means of revenue. It was "to promote the progress of the useful arts," not to levy a tax upon such progress; least of all in the vexatious form of a deferred payment, which will fall due at a time when the franchise will have become distributed among more or less numerous holders, not personally known to one another, and who will be under no legal obligation to recoup one of their number who shall have the vigilance and generosity to pay the mulct out of his own pocket.

2. Why should such a tax be levied? The last report of

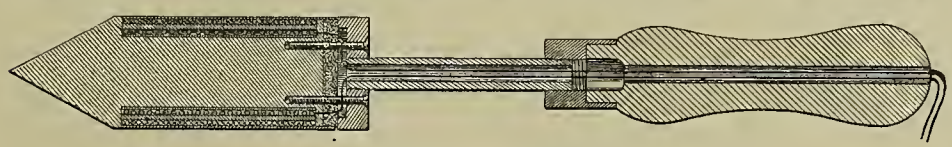
the commissioner of patents shows the bureau to have been not only self-supporting, but to have annually paid into the public treasury amounts which now aggregate about $5,000,000 in excess of its expenditures. We venture to say that the prosperity and renown of these United States are mainly due to its inventors, and that in spite of blundering and meddlesome legislation. The proposed measure, if it becomes a law, will make respectable by comparison, the act of Esop's peasant who in a moment of blind thriftiness slew the bird that laid his golden eggs.

Much more might be said and it may be hoped will be said, and that promptly, by gentlemen who both in knowledge of the subject and by their position, are much better qualified to influence legislation. GEO. H. KNIGHT.

New York, June 9, 1890.

Carpenter Electric Soldering Iron.

A number of inventors are at work devising apparatus through which the heating effect of the electric current may be utilized. The cut



CARPENTER ELECTRIC SOLDERING IRON.

presented herewith illustrates one of the latest improvements in the line of electric soldering irons. The invention is quite simple. The body of the tool is provided with an annular peripheral recess. In this is wound about the core, first, a layer of thin asbestos paper, or some other suitable electrical insulating material, capable of withstanding the action of intense heat. Upon the asbestos is wound, in a spiral coil, a wire resistance, the volutes of the coil being sufficiently separated to prevent short-circuiting. Over this conductor is wound a thick sheet of asbestos, which acts both as an electrical and heat insulator to prevent the dissipation of heat by radiation. The whole is bound together by a winding of asbestos thread, which serves to retain the elements in close relation to each other and to the iron body or core under pressure, so as to utilize to the maximum degree the heat generated by the passage of the current. The asbestos and the coils are covered on the outside with a metallic sheath or jacket which extends beyond the inner end of the body-iron, so as to furnish a recess for an insulating layer of asbestos. This asbestos is interposed between the end of the body and a ring attached by means of screws to a hollow handle. The conducting wires pass down through the hollow handle, as indicated.

The Telegraph and the Lottery.

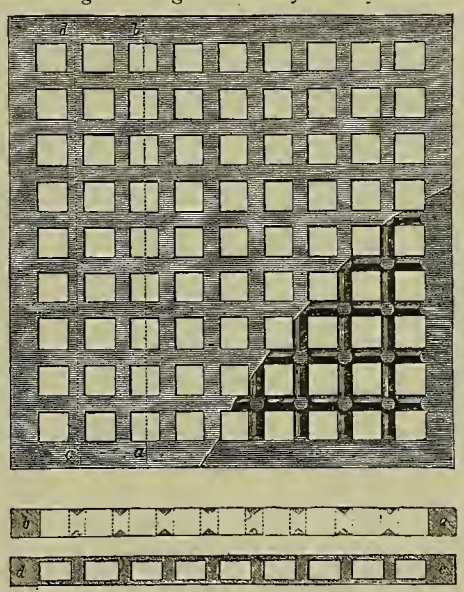
A great many charges have been made against the Louisiana Lottery company in connection with its attempt to secure a charter in North Dakota. It is alleged that the lottery company's agents by bribery were enabled to secure the services of several telegraph officials in order to secure the speedy transmission of these dispatches, and to effect the delay of their opponents. On the night of Feb. 4 the wires of the Western Union were cut about two miles east of Jamestown. Two operators, along with a railroad employe were supposed to have done the work, and they appeared to have operated under well-defined instructions. At that time telegrams went flying thick and fast, both for and against the lottery scheme. The enterprising agents, it is said, managed very cleverly to "sidetrack" the unfavorable telegrams, and to rush the others through. They were also charged with furnishing the contents of the anti-lottery people's telegrams to a friendly lobby in advance of their proper delivery. Those on the inside had good reason to wear a sanguine front. The lottery crowd was put in possession of the plans and secrets of its opponents in advance and communication was established for it in every part of the state. Petitions and lists of names in its favor were promptly forwarded free of charge. All papers otherwise drawn up were purposely delayed and overcharged, or sent too late to be of any effect, it is alleged.

The Western Union woke up with a start. The charges of tampering and collusion were too specific to be overlooked. Its service would suffer. The public would lose all confidence in it. After a rigid investigation it presented a statement of facts to the county attorney of Stutsman county. The attorney prepared the case, submitting it to Judge Roe. Acting under his powers the latter refused to call the grand jury together, on the ground that an extra session would entail too much expense.

Thus matters stand now. The next regular term of the court will open in September, and the Western Union people declare that they will renew their efforts to secure an indictment.

Hagen Accumulator Plate.

The efforts of makers of accumulators tend in two directions. They wish to make a plate in which the active material will be held firmly in position, and at the same time they desire to decrease the weight of their cells by making the grids as light as possible. Dr. E. Sieg, in an article in the *Elektrotechnishe Zeitschrift*, calls attention to a new form of grids, constituting the characteristic feature of the Hagen storage battery system, which he says more nearly fulfills the conditions of retaining firmly the litharge and of lighter weight than any cells yet manu-

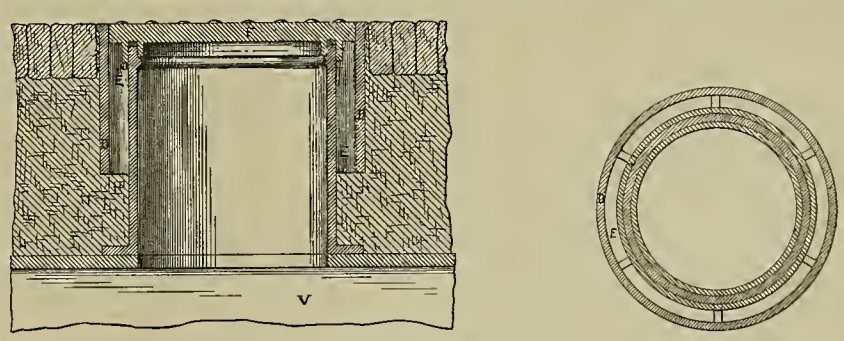


HAGEN ACCUMULATOR PLATE.

factured. The general features of the plate are shown in the accompanying cut. In the ordinary Hagen cells the proportion of the active material to the weight of the plates is stated to be 1:1, though the weight of the grids can be materially reduced when batteries, in which light weight is the great desideratum, are desired.

Improved Cover for Subway Vaults.

The new manhole cover represented in the cuts was designed with the object of preventing the inflow of surface-water into a vault or subway.



IMPROVED COVER FOR SUBWAY VAULTS.

The novel feature of the invention consists in the combination with the inclosing-wall of a manhole of an outer concentric casing placed so as to leave an open interval between the two and carried up higher than the inner wall, and of a cover constructed as represented. A glance at the illustration will show that the upper edge of the outer wall *D* is brought to the level of the ground or pavement, so that the top of the cover *F*, fitted within it, shall be at the same level. The cover *F*, when in place, completely protects the vault *V* from the possible inflow of water falling upon or flowing over the cover. Any of the water which may work its way through the joint between the cover and the outer wall *D* will drop into the drip-chamber *E*, and thence percolate and be carried off from the bottom through the ground.

This cover is the invention of J. Stafford, New York.

Postal Telegraph Project.

It is generally understood at Washington, according to recent telegraph dispatches, that there will be a report on the question of establishing a postal telegraph system this session, though as yet there have been no means of ascertaining how the members consider the project. Dr. Green was recently invited to make a statement as to the cost of maintenance of the proposed system, and furnish such figures as his experience in the telegraph business might suggest. He has consented to do this, and a meeting will soon be held at which the question will be considered. On the other hand the postmaster-general will review the testimony taken by the committee, and will make an argument in favor of his pet scheme. The bill originally suggested by the postmaster-general, authorized him to enter into a contract with responsible persons to connect a certain number of postoffices for telegraphic purposes by leased wires and instruments, to be operated by postoffice employes to carry messages for the government and the people. It is now proposed to change the original bill by substituting a clause providing that the instruments leased by the government shall be operated by employes of the contracting company and not by federal employes. The friends of the bill say this change meets the objection that has always been raised to postal telegraphy, that it would enormously increase the government's patronage. This, however, is not the case. The opponents of the bill will find additional reason for complaint under the proposed change, for in it they cannot fail to see an effort on the part of the government to shift responsibility. The appointments will be controlled by the party in power at Washington, and therefore it makes little difference whether the employes are paid by the government directly, or through the contracting company. The objection of the opponents of the bill is based on their opposition to governmental interference. They object to the government having anything to do with the service, no matter how remotely. When the project was first presented in its present form it found many supporters who were attracted by what they considered the novelty of the plan, yet it has been rejected successively by many former administrations. The tendency to-day is against the measure. The newspapers of the country are generally opposed to the project, and a careful scrutiny of the forces shows that Mr. Wanamaker will be obliged to contend with the ablest journalists and the most conservative business men in the country if he endeavors to force the question to a discussion in Congress.

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PUBLICATION OFFICES:
6 Lakeside Building. - - CHICAGO
Telephone 1740.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. H. O'HARA, - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

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THE executive committee of the National Telephone Exchange association has fixed upon September 9th as the date of holding the Detroit convention of the organization. Many matters of interest are to come before the association, and it is predicted that the convention will be of a most interesting character.

IN a communication published in another column, George R. Knight argues against a section in a bill introduced in the House of Representatives relating to patents. It is proposed that the patentee pay to the government a certain tax after the issue of a patent. Mr. Knight questions the constitutionality of the proposed section, but even assuming its validity, he can see no good reason for levying a tax on inventors. The great majority of inventors will share in these opinions of Mr. Knight.

IN another column is presented an interesing account of Prof. Elihu Thomson's electro-magnetic induction experiments. These experiments which were recently repeated by Prof. J. A. Fleming of University College, London, before the Society of Arts, illustrate, as Prof. Fleming says, "Some highly remarkable and interesting facts in electro-magnetic induction." It might be well to say in this connection that just such simple experiments as these warrant the closest study. The student of to-day feels himself to be a progressive individual and is too prone to believe that time is wasted unless devoted to the study of the more complex problems of his science. A few simple appliances, such as those illustrated in the numerous cuts presented, together with the desire to "see for himself" will enable many an ambitious student of alternating current effects to post himself on a subject as yet practically unknown to many.

INVENTORS working on the problem of electric braking will find this description of a magnetic clutch, presented in another column, to be suggestive. In this device the inventor proposes to utilize the pull of an electro-magnet, and thus do away with mechanical friction.

IT has been stated in a number of papers of late that the alley elevated road in Chicago was soon to be operated by storage batteries. Much as we should like to confirm the report, we are obliged to state that there is no immediate probability that an elevated storage battery road will be in operation in Chicago. It is more than likely that trains on the alley road will not even employ electric motors at the outset, though it is doubtless true that this road with the great majority of elevated railways, will eventually depend on electric power.

THE Chicago City electric light system for street illumination was inaugurated about eighteen months ago by lighting a few streets on the West and South sides of the river from the Jefferson street power house. The undertaking was largely in the nature of an experiment but it proved successful. The system gained in popularity and was gradually enlarged until to-day the city has the nucleus of a first-class underground electric light system for street illumination. In this issue two views of the dynamo room of the new West-side power house, which replaced the original station are given, together with the plans for the new South side building which will be erected this summer.

THE New York *World*, in a recent issue, gives an illustration which is entitled, "A Prophetic Illustration of One of New York's Busiest Streets as it Ought to Appear before Many Years." The distinctive feature about the view is the fact that the walks for pedestrians have been elevated, so that they are on a level with the second stories of the buildings. It is noticeable, too, that wires have disappeared. There is one fatal defect in the picture. Street cars are drawn by the same sleepy horses that are now seen on the streets of the metropolis. Long before such a radical innovation is made as the elevation of the walks, horses for drawing cars will have disappeared and rapid transit will be effected by electricity.

THE insertion of a fusible strip into a live incandescent circuit, either alternating or direct-is, to say the least, not a pleasant operation. One is apt to be in too great a hurry. With a number of lights cut out, and a vivid realization of the fact that a customer's complaints will increase as the cube of the time that darkness prevails, certain necessary precautions very likely will be neglected. It is more satisfactory, to express it very mildly, to have a fuse blow a little while after insertion than when between one's fingers. The practical reader, then, will appreciate the idea suggested in the construction of the fuse box, described in another column. Mr. Kammeyer's device is as simple as it is ingenious. The building posts for the fuse are attached to the lid of the outer case. This lid is hinged or made so that it may be slid into place. Until the lid is in place no electrical connection is established. Shutting the box inserts the fuses into their respective circuits.

MANAGERS of gas plants have furnished proof of the growing popularity of electric light on many occasions during the last year, and it is a significant fact that the most progressive men in that department are giving the subject their close attention. In this connection it should be considered that gas men show great reluctance in admitting publicly the superiority of electric lights, and the advocates of the latter are certainly justified in making the most of utterances which in many cases are so grudgingly given. Among the recent significant utterances on this point by gas managers, that of President Faben of the Western Gas association is noticeable. In his annual address he admits the superiority of the arc light for street illumination, and says: "It has no equal." The incandescent light is gaining ground he admits, and he thinks the meter system should be generally adopted. In the question of investment Mr. Faben, as a practical business man of course, is greatly interested. He does not look upon the industry under the system of charging for lamps rather than the current consumed as a profitable investment, at least that may be considered a fair inference from his remarks. It should be noted, however, that the owners of securities in electric lighting concerns are not desirous of disposing of their holdings.

A GLANCE over the patents on electrical apparatus, allowed during the last year, shows that a number have been issued for electrical heaters. It is noticeable, however, that there exists a lack of originality in the methods employed by the patentees. Heater after heater has been designed, but still the larger number of the inventors have apparently done little more than remodel apparatus already well covered by claims previously allowed. Unquestionably there is a field to be developed in this direction. The most efficient heater yet produced cannot be said to be economical, yet there are many cases where the advantages of this method would more than counterbalance the increased expense of operation. In small devices where heat is required on tap, so to speak, as for instance, in the soldering iron, the convenience and other advantages of the electric method are obvious. With the present comprehensive and rapidly extending systems for distributing current, we see no reason why an effort in this direction would not bring encouraging results. The lighting companies, both incandescent and arc, as well as the electric street car companies, are in the market to sell their product, and from them the exploiter of a successful heater would receive every assistance. It must not be forgotten when we hear the cry "uneconomical," that incandescent electric lighting, now successful in every respect, was from the start and is now in one sense uneconomical as compared with gas. The people, however, have learned to weigh other advantages as well as that of cost.

ELSEWHERE in this issue are presented the opinions of a number of distinguished European scientists relative to the infliction of the death penalty by electricity. No one will be surprised to learn that with one exception the gentlemen whose views are presented condemn electrocution very vigorously. Dr. Werner von Siemens while he does not condemn the substitution of the electric current for the rope, still thinks the Americans are a very queer people to desire to make a change. The grounds on which the Europeans based their objections to electrocution are by no means novel. Their reasons sound very familiar to those who have followed the arguments of counsel in the Kemmler case. In brief they object to the employment of the electric current on the ground that it is uncertain and that its application very likely would cause the condemned criminal to suffer the most excruciating torment. Dr. D'Arsonval develops this idea in an exceedingly interesting way. It was stated at the Kansas City convention of the National Electric Light association, and the statement was doubtless correct, that the citizens of New York state desired to have the new method tested, in spite of the almost unanimous protest of electricians. This determination is so fixed that there is no probability that a change in the law will be made very soon. The expressions of opinion from the other side of the Atlantic, while they will have no particular effect in New York state, will be a powerful argument to deter other legislatures from following the example of that of New York. Bills providing for electrical execution have been introduced in the legislatures of many states, and very likely will be presented again next winter. These European protests will greatly strengthen the opposition to them.

Prof. Elihu Thomson's Electro-Magnetic Induction Experiments.[1]

By J. A. Fleming, M. A.

PART I.

In the Paris Exposition of 1889, and in the United States Court, many present will, perhaps, recollect to have seen a collection of electrical apparatus, contributed by Prof. Elihu Thomson as his private exhibit. These pieces of experimental apparatus constituted the appliances for illustrating some highly remarkable and interesting facts in electro-magnetic induction It is more than probable that very many persons interested in electrical discovery either did not find, or did not happen to see in action, these instruments, or perhaps had not the opportunity to see them at all. By the kindness of Prof. Elihu Thomson, to whom I am indebted for the loan of the apparatus, it is in my power to repeat some of these experiments before you to-night; and my obligations are likewise especially due to Ernst Thurnauer, the engineer of the European Thomson-Houston Electric Light company, for affording me his valuable aid in bringing them before you, and to Mr. Garfield, of the Thomson Electric Welding company, for assistance in preparing the experiments. A few introductory remarks will be essential, in order that I may carry the whole of my audience with me in subsequent explanations; and these remarks will refer to that which is so very familiar a subject to every electrician, viz.,

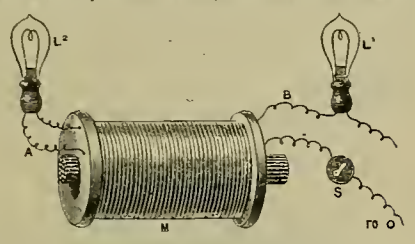


FIG. 1.

the mutual induction of electric circuits. Before me lies a very large bobbin, or spool, wound over with two insulated copper wires. These wires were wound on the spool together, and for convenience sake we will distinguish them by calling them *A* and *B* Fig. 1. Bear in mind that the wires or circuits are insulated from each other throughout their entire length, but lie closely adjacent on the bobbin. I can at pleasure insert a large bundle of soft iron wires tied up together into the hollow split brass tube which forms the body or the spool The ends of one wire, say *A*, are connected to the terminals of a glow lamp, and I can pass or interrupt an electric current which traverses the other circuit, *B*, and a second glow lamp in series with it. You will note at once what happens when I start or stop the electric current in the circuit *B*. The lamp connected to circuit *A* flashes up momentarily at the instant when the current begins to flow in circuit *B*, and also when it ceases to flow; but while the current flows steadily in the circuit *B*, and illuminates the lamp in series with it, the lamp in series with circuit *A* is not illuminated at all. We have here a lecture experiment illustrating the familiar classical discovery of Faraday of the mutual induction of two electric circuits, viz , that the starting and stopping of an electric current in one circuit induces at the instant of commencement or cessation a brief secondary current in another closed adjacent circuit. I shall not take up time by dwelling on the historical details of this fundamental fact. You know them well. If, instead of starting and stopping a continuously flowing electric current through the circuit *B*, and observing at each "make" or "break" a brief secondary current in circuit *A*, we supply the circuit *B*, with an alternating electric current, one of which the direction is rapidly reversed many times in a second, and connect as before a glow lamp in series with circuit *A*, we find that this lamp glows continuously whilst the alternating current flows in circuit *B*. This also is familiar to us all.

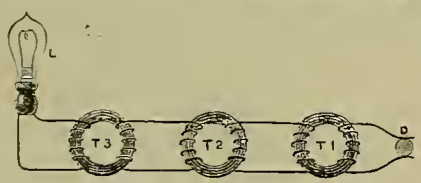


FIG. 2.

If in our first experiment we had employed, as a current detector in the secondary circuit, not an incandescent lamp, but some kind of galvanometer capable of indicating the direction of the induced electric current, we could easily have established for ourselves the fact that at the instant when the continuous electric current begins to flow in the circuit *B*, it generates an oppositely directed induced secondary current in the circuit *A*, which is merely transient current. At the instant when the continuous current is interrupted in circuit *B*, it gives rise to a similarly directed transient induced electric current in the circuit *A*. The momentary currents in *A* are called the *inverse* and *direct* secondary currents, induced by the commencement or cessation of the continuous primary current in circuit *B*. If the primary current is rapidly reversed, as in the case of an alternating current, then the secondary current consists likewise of a rapid succession of currents alternating in direction. In most of our experiments this evening we shall employ an alternating current, having a "frequency" of 90 per second—that is to say, changed in direction in the circuit 180 times in a second.

[1] Read before the London Society of Arts, May 14, 1890.

If such an alternating current traverses a primary circuit, it induces a secondary alternating current of the same frequency in an adjacent secondary circuit, and this secondary periodic current may be made to induce in another circuit a tertiary current of like frequency, and this, again, a quaternary current; and so on: these successive orders of induced currents being as it were. the children, grandchildren, and great-grandchildren of the primary parent current to which they owe their birth, Fig. 2.

The same large spool of insulated wire will provide us with the means of illustrating another important fact. I join up the two wires, *A* and *B* into one length, so as to form one continuous bobbin of wire, and connect this great spiral of wire with a couple of glow lamps, one being in series with the wire spiral and the other being parallel with it, Fig. 3. On sending a steady current through the system, it divides between the wire spiral, *S*, and the lamp, L^1, and I adjust the strength of this current so that the lamp, L^1, is barely visibly red hot. On interrupting suddenly this electric current, the lamp, L^1, flashes up for a moment. We recognize that we have here to consider an inertia effect familiar to us as the effect of "self-

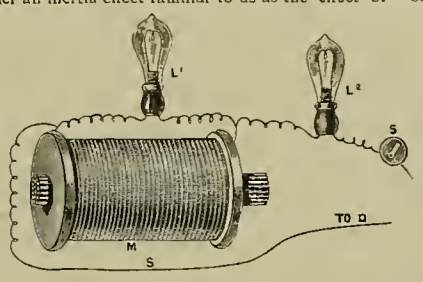


FIG. 3.

induction" in the long coil of wire. Audiences in this room have been so carefully informed on many past occasions by brilliant and capable teachers, that I may spare you a reiteration of elementary facts concerning the self-induction or inductance of conducting circuits, and take it for granted that every one here is intimately acquainted with them, and that you will recall to your recollection that when an electromotive force acts upon any closed electric circuit generating in it an electrical current, this self-induction exhibits itself by delaying or retarding the rise of the current strength to its full or its maximum value; and that, similarly, when the electromotive force is withdrawn, it operates to give the current a persistence, or to retard the rate of reduction of the current strength. The convenient term "time constant" of a circuit is employed to denote that time, expressed in fractions of a second or any other unit, which must elapse before a current rises to a certain definite fraction of its full value, when a steady electromotive force acts upon that circuit. I will next beg you to turn a moment's attention to the electro-dynamic actions or forces which are brought into play when a circuit of any kind is subjected to electro-magnetic induction in a magnetic field. Consider, for instance, a ring of copper hanging in front of the pole of

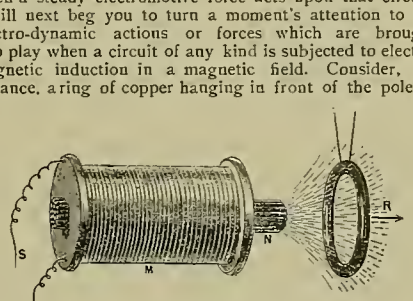


FIG. 4.

an electro-magnet Fig. 4, having the plane of the ring perpendicular to the lines of magnetic force proceeding out from the pole. Let the magnet be an electro-magnet, and let the pole be suddenly made a north or marked pole. Lines of magnetic force are thrust into the aperture of the ring. This magnetic flux, in accordance with a well-known law, generates an inductive electromotive force which causes a transient current to flow round the ring in a counter clockwise direction, as looked at *from* the north magnetic pole. The ring becomes virtually a *magnetic shell*, having a north pole facing the north pole of the exciting magnet. By the fundamental laws of action between currents and magnets established by Ampere, the ring experiences a slight repulsive force, due to the electro-dynamic action between the current in the ring and the magnetic pole. The generation of the momentary induced current in the ring is accompanied by an electro dynamic impulse tending to thrust it away from the pole. Suppose, next, that the electro-magnet is demagnetized. The ring has generated in it a reverse induced current flowing in the same direction as the hands of a clock move when looked at from the magnetic pole. This is also accompanied by

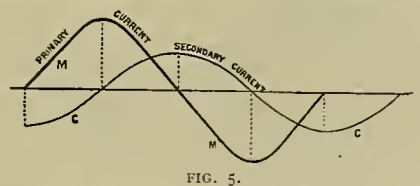


FIG. 5.

an electro-dynamic attraction of the ring toward the pole, but which is much more feeble than the previous repulsion. These attractions and repulsions are well seen when small discs of copper or aluminum are suspended in front of the poles of a powerful electro-magnet, which is alternately "made" and "broken." They have been particularly investigated by C. V. Boys.

I will now ask you to consider what would happen if the coils of the electro-magnet were traversed by an alternating current? Furthermore, we shall first suppose that the copper ring has a zero time constant, that is to say, the induced currents in the ring rise up and sink down in strength in exact synchronism with the changes in the inductive electromotive force acting on the ring. If the current flowing in the coils of the electro-magnet is represented as to changes in strength by a simple periodic curve, we may suppose that the magnetism of the core and the magnetic induction through the ring follow a similar law. It is very easy, then, to show that the induced electromotive force acting in the ring circuit, and hence the current in the ring follows a similar law of fluctuation, but that the instant of maximum current in the ring coincides with the instant of reversal of magnetism in the electro-magnet. Under these circumstances we can represent the changing strength of the magnetic field in which the ring is immersed by a simple periodic curve, *M*, and the changes of current strength in the ring circuit by another simple periodic curve, *C*, shifted backward relatively to the first by a quarter of a wave length, Fig. 5.

By Ampere's law, the force acting on the ring at any instant is proportional to the product of the instantaneous value of the surrounding field and this current strength. If we multiply together the ordinates of these two curves, *M* and *C*, and form a third curve, *P*, whose ordinate at every point is proportional to the product of the ordinates of the other curves, Fig. 6, at these points, we obtain a

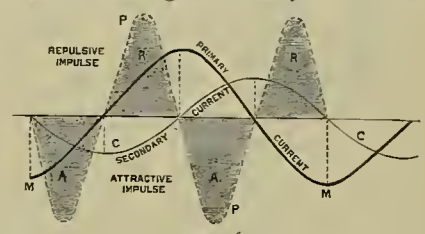


FIG. 6.

curve which represents the fluctuation of force at every instant acting upon the ring. This curve, *P*, is also a wave-like curve, lying symmetrically above and below the horizontal line. The positive and negative areas of this curve included between the curve and the horizontal line represent the impulses or time integrals of the forces which act upon the ring. These impulses are alternately positive and negative. This is equivalent to saying that under the circumstances assumed the ring gets a series of small pushes and pulls, or repulsions and attractions, which succeed each other at the same rate as the changes of magnetic polarity of the magnet. The series of rapidly alternating and equal impulses would result in leaving the ring apparently unmoved. No real conducting ring can, however, behave in this fashion, because every ring has a sensible "time-constant." Let us next see how the above statements will be modified if the ring has such a sensible self-induction that the current induced in the ring lags behind the inducing electromotive force in phase. Repeating the above construction for a force curve, on the assumption that the instant of maximum of the current in the ring occurs later than the instant of reversal of magnetism in the magnet, it is easy to see that the force curve consists now of two very unequal parts. It is not symmetrically situated with respect to the horizontal lines, Fig 7. The area of the hummocks (shaded portions) which lie above the datum line, and which represent the repulsive impulses on the ring, are much larger than the area of the hummocks below the datum line, and which represent the attractive impulses acting on the ring. This means to say, that the ring when possessing self-induction experiences on the whole a repulsive force, or a series of repulsive impulses, when immersed in such an alternating magnetic field radiated from a magnetic pole; and this repulsive force will be,

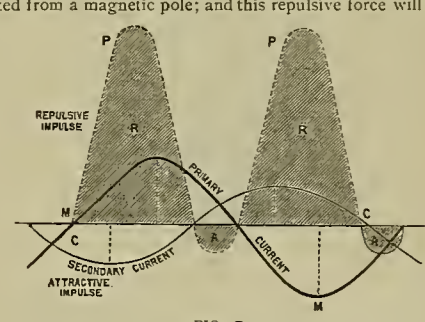


FIG. 7.

within certain limits, more pronounced, other things being equal, the greater the time constant of the circuit. You see clearly, therefore, that a ring or disk of copper, in which the induced currents lag behind the inducing electromotive force in phase must experience a repulsive force when this inducing electromotive force is caused by a rapid flux backward and forward of lines of magnetic forces perforating through the ring or disk. The realization of this inference in a striking manner is the first of a series of remarkable experiments on this subject due to Prof. Elihu Thomson. We have on the table an electro-magnet suitable for these experiments, which consists of a core of divided iron, surrounded by a coil in which I can cause to circulate a powerful alternating current of 40 to 50 amperes. Let us, however, begin with an experiment in which we employ a continuous current to energize the core. I give you, in Prof. Elihu Thomson's own words, an account of this preliminary experiment:

"In 1884, while preparing for the International Electrical Exhibition at Philadelphia, we had occasion to con-

struct a large electro-magnet, the cores of which were about six inches in diameter and about twenty inches long. They were made of bundles of iron rod about $\frac{5}{16}$ of an inch in diameter. When complete, the magnet was energized by a current from a continuous-current dynamo, and it exhibited the usual powerful magnetic effects. It was found, also, that a disk of sheet copper of about $\frac{1}{16}$ of an inch in thickness and ten inches in diameter, if dropped flat against a pole of the magnet, would settle down softly upon it, being retarded by the development of currents in the disk, due to its movement in a strong magnetic field, and which currents were of opposite direction to those in the coils of the magnet. In fact, it was impossible to strike the magnet pole a sharp blow with the disk, even when the attempt was made by holding one edge of the disk in the hand, and bringing it down forcibly toward the magnet. In attempting to raise the disk quickly off the pole, a similar but opposite action of resistance to movement took place, showing the development of currents in the same direction as those in the coils of the magnet, and which currents, of course, would cause attraction as a result. The experiment could be tried in another way. Holding the sheet of copper by one edge, just over the magnet pole, Fig. 8, the current in the magnet coils was cut off by shunting them. There was felt an attraction of

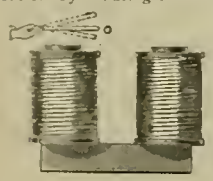


FIG. 8.

FIG. 9.

FIG. 10.

the disk, or a dip toward the pole. The current was then put on by opening the shunting switch, and a repulsive action or lift of the disk was felt. The actions just described are what would be expected in such a case, for when attraction took place currents had been induced in the disc in the same direction as those in the magnet coils beneath it, and when repulsion took place the induced current in the disk was of opposite character or direction to that in the coils. Now let us imagine the current in the magnet coils to be not only cut off, but reversed back and forth. For the reasons just given, we find that the disk is attracted and repelled alternately; for whenever the currents induced in it are of the same direction with those in the inducing or magnet coil, attraction will ensue, and when they are opposite in direction repulsion will be produced. Moreover, the repulsion will be produced when the current in the magnet coil is rising to a maximum in either direction, and attraction will be the result when the current of either direction is falling to zero, since in the former case opposite currents are induced in the disk, in accordance with well-known laws; and in the latter case currents of the same direction will exist in the disk and the magnet coil. The disk might, of course, be replaced by a ring of copper or other good conductor, or by a closed coil of bare or insulated wire, or by a series of disks, rings, or coils superposed, and the results would be the same."

We have already seen that in an alternating field the electro-dynamic impulses so experienced by the disk or ring are alternately attractive and repulsive, and that when the circuit possesses a sensible self-induction, the repulsive impulses overpower the attractive ones, and their repetition constitutes a repulsive force. Before adding a few more words of explanation, permit me to show you some of these electro-dynamic repulsions produced by an alternating electro-magnet. Here is a copper ring, and I lay upon it the top of this electro-magnet, having a divided iron core, and excited by a powerful alternating current. On energizing the magnet, the ring jumps up in the air, Fig. 9. If a copper plate is hung like a scale pan from a balanced beam, and placed over the magnetic pole, it gives

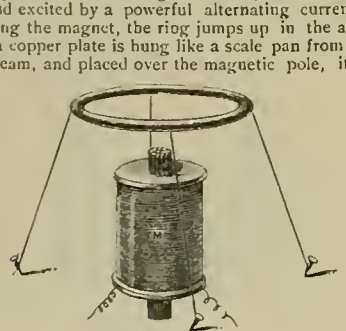


FIG. 11.

evidence of being strongly repelled the moment we pass the current through the coils of the magnet, Fig. 10. Instead of employing copper rings or copper plates, we can use closed coils of thick wire, either insulated or not. If, however, our plates or rings have a radial slit made in them, or if our coils of wire are not closed-circuit coils, all the effects vanish.

So strong is this repulsion, with proper appliances, that light copper rings tethered by strings may be held suspended in the air against the force of gravity, the upward electro-magnetic repulsion overcoming their weight, and holding them, like Mahomet's fabled coffin, floating in the air, Fig. 11. In cases where we are dealing only with impulsive effects, aluminum rings or disks give most marked results, because aluminum has the highest conductivity per unit of mass; but in the cases like those just considered, where what is required is the greatest force effect, copper or silver gives a better result than aluminum, because they have the highest conductivity per unit of volume. In Mr. Boys' experiments, if I remember rightly, he found aluminum the best to employ. In these cases of electro-dynamic repulsion, the force effect depends essentially upon the lag of the induced current, or its retardation in phase, behind that of the inducing field, and, other things being equal, this is proportional to the conductivity of the circuit. I will pass before your view a series of diagrams intended to represent various cases and modes of production of these repulsive effects, giving you descriptions of them in Prof. Elihu Thomson's own words. He says:

"This preponderating repulsive effect may be utilized or may show its presence by producing movement or pressure in a given direction, by producing angular deflection as of a pivoted body, or by producing continuous rotation in a properly organized structure.

"In Fig. 12, *C* is a coil traversed by alternating currents,

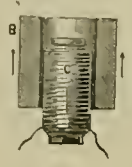


FIG. 12.

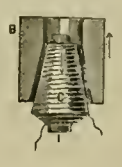


FIG. 13.

FIG. 14.

B is a copper case or tube surrounding it, but not exactly over its center. The copper tube, *B*, is fairly massive, and is the seat of heavy induced currents. There is a preponderance of repulsive action tending to force the two conductors apart in an axial line. The part *B* may be replaced by concentric tubes slid one in the other, or by a pile of flat rings, or by a closed coil of coarse or fine wire, insulated or not. If the coil, *C*, or primary coil, is provided with an iron core, such as a bundle of fine iron wires, the effects are greatly increased in intensity, and the repulsion with a strong primary current may become quite vigorous, many pounds of thrust being producible by apparatus of quite moderate size.

"The forms and relations between the two parts, *C* and *B*, may be greatly modified, with the general result of a preponderance of repulsive action when the alternating currents circulate.

"Fig. 13 shows the part *B* of an internally tapered or cone form, and *C* of an externally cone form, wound on an iron wire bundle, *I*. The action in Fig. 12 may be said to be analogous to that of a plain solenoid with its core, except that repulsion, and not attraction, is produced; while that of Fig. 13 is more like the action of tapered or conically-wound solenoids and taper cores. Of course it is unnecessary that both be tapered. The effect of such shaping is simply to modify the range of action and the amount of repulsive effort existing at different parts of the range.

"In Fig. 14 the arrangement is modified so that the coil, *C*, is outside, and the close band or circuit, *B*, inside and

FIG. 15.

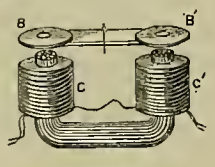


FIG. 16.

around the core, *I*. Electro-inductive repulsion is produced as before.

"It will be evident that the repulsive actions will not be mechanically manifested by axial movement or effort, when the electrical middles of the coils or circuits are coincident. In cylindrical coils, in which the current is uniformly distributed through all the parts of the conductor section, what I here term the electrical middle, or the center of gravity of the ampere-turns of the coils, will be the plane at right angles to its axis at its middle, that of *B* and *C* in Fig. 14 being indicated by a dotted line. To repeat, then, when the centers or center planes of the conductor, Fig. 14, coincide, no indication of the electro-inductive repulsion is given, because it is mutually balanced in all directions; but when the coils are displaced a repulsion is manifested, which reaches a maximum at a position depending on the peculiarities of proportion and distribution of current at any time in the two circuits or conductors.

"In Fig 15 *B* represents a copper ring, and *C* an annular coil placed parallel thereto; and an iron core or wire bundle placed in the common axis of the two coils, shows the repulsive action when an alternating current is passed through *C*. *B* may be simply a disc or plate of any form, without greatly affecting the nature of the action produced. It may also be composed of a pile of copper washers or a coil of copper wire, as before indicated.

"An arrangement of parts somewhat analogous to that of a horseshoe electro-magnetic and armature is shown in Fig. 16. The alternating current coils, *C*, *C'*, are wound upon an iron wire bundle bent into U-form, and opposite

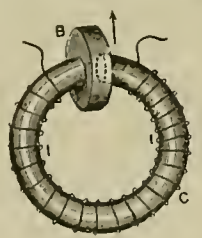


FIG. 17.

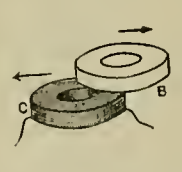


FIG. 18.

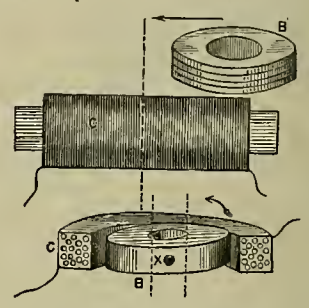
its poles is placed a pair of thick copper disks, *B*, *B'*, which are attracted and repelled, but with an excess of repulsion depending on their form, thickness, etc.

"If the iron core takes the form of that shown by *I*, *I*, Fig. 17, such as a cut ring with the coil, *C*, wound thereon, the insertion of a heavy copper plate, *B*, into the slot or divided portion of the ring, will be opposed by a repulsive effort when alternating currents pass in *C*. This was the first form of device in which I noticed the phenomenon of repulsive preponderance in question. The tendency is to thrust the plate, *B*, out of the slot in the ring, excepting only when its center is coincident with the magnetic axis joining the poles of the ring between which *B* is placed.

"If the axes of the conductors, Fig. 15, are not coincident, but displaced, as in Fig. 18, then, besides a simple repulsion apart, there is a lateral component or tendency, as indicated by the arrows. Akin to this is the experiment illustrated in Fig. 19. Here the closed conductor, *B*, is placed with its plane at right angles to that of *C*, wound on a wire bundle. The part *B* tends to move toward the center of the coil, *C*, so that its axis will be in the middle plane of *C*, traverse to the core, as indicated by the dotted line. This leads us at once to another class of action, *i.e.*, deflective actions.

"When one of the conductors, as *B*, Fig. 20, is composed of a disk or better, of a pile of thin copper discs, or of a closed coil of wire, is mounted on an axis, *N*, transverse to the axis of coil, *C*, through which coil the alternating current passes, a deflection of *B* to the position indicated by dotted lines will take place, unless the plane of *B* is at the start exactly coincident with that of *C*. If slightly inclined at the start, deflection will be caused as stated. It matters not whether the coil, *C*, incloses the part B, or be inclosed by it, or whether the coil, *C*, be pivoted, and *B* fixed, or both be pivoted. In Fig. 21 the coil, *C*, surrounds an iron wire core, and *B* is pivoted above it, as shown. It is deflected, as before, to the position indicated in dotted lines.*

"It is important to remark here that, in cases where deflection is to be obtained, as in Figs. 20 and 21, it had best be made of a pile of thin washers or a closed coil of



FIGS. 19 AND 20.

insulated wire, instead of a solid ring. This avoids the lessening of effect which would come from the induction of currents in the ring, *B*, in other directions than parallel to its circumference."

Returning for a moment to the theory of these repulsive and deflective actions, it will repay us to consider it in the form placed before us by Prof. Thomson, in his first paper on the subject, read before the American Institute of Electrical Engineers, May 18, 1887. He says:

"It may be stated as certainly true that, were the induced currents in the closed conductor unaffected by any self-induction, the only phenomena exhibited would be alternate equal attractions and repulsions, because currents would be induced in opposite directions to that of the primary current when the latter current was changing from zero to maximum positive or negative current, so producing repulsion; and would be induced in the same direction when changing from maximum positive or negative value to zero, so producing attraction.

"This condition can be illustrated by a diagram, Fig. 22. Here the lines of zero current are the horizontal straight lines. The wavy lines represent the variations of current strength in each conductor, the current in one direction being indicated by that portion of the curve above the zero line, and in the other direction by that portion below it. The vertical dotted lines simply mark off corresponding portions of phase or succession of times.

"Here it will be seen that in the positive primary current descending from *M*, its maximum, to the zero line,

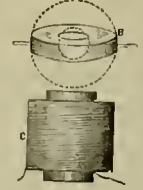


FIG. 21.

the secondary current has risen from zero to M^1, its maximum. Attraction will therefore ensue, for the currents are in the same direction in the two conductors. When the primary current increases from zero to its negative maximum, *N*, the positive current in the secondary closed circuit will be decreasing from M^1, its positive maximum, to zero; but, as the currents are in opposite directions, repulsion will occur. These actions of attraction and repulsion will be reproduced continually, there being a repulsion, then an attraction, then a repulsion, and again an attraction, during one complete wave of the primary current. The letters *R A*, at the foot of the diagram, Fig. 22, in-

*This deflection by an alternating current of a copper disk suspended within a coil with its plane inclined to the plane of the coils, I myself noticed independently, in March, 1887, and subsequently described a copper disk galvanoscope for alternating currents, based on this fact (see the ELECTRICIAN, May 6, 1887). I did not, at the time, know how thoroughly Prof. Thomson had explored the phenomena, but the substantial explanation of it had already occurred to me.

dicate this succession. (The shaded portions in the diagrams represent the time during which the force between the primary and secondary circuits is a repulsive force.)

"In reality, however, the effects of self induction in causing a lag, shift, or retardation of phase in the secondary current, will considerably modify the results, and especially so when the secondary conductor is constructed so as to give to such self-induction a large value. In other words, the maxima of the primary or inducing current will no longer be found coincident with the zero points of the secondary currents. The effect will be the same as if the line representing the wave of the secondary current in Fig. 22 had been shifted forward to a greater or less extent. This is indicated in diagram, Fig. 23. It gives, doubtless, an exaggerated view of the action, though from the effects of repulsion which I have produced I should say it is by no means an unreliable condition.

"It will be noticed that the period during which the currents are opposite, and during which repulsion can take place, is lengthened at the expense of the period during which the currents are in the right direction for attractive action. These different periods are marked *r*, *a*, etc., or the period during which repulsion exists is from the zero of the primary or inducing current to the succeeding zero of the secondary or induced current; and the period during which attraction exists is from the zero of the induced current to the zero of inducing current. (It will be seen that the shaded portions in diagram 23 have been widened out at the expense of the unshaded parts.)

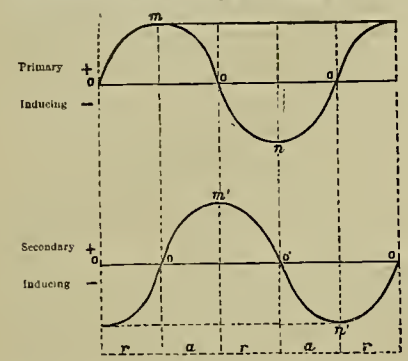


FIG. 22.

"But far more important still in giving prominence to the repulsive effect than this difference of effective period, is the fact that during the period of repulsion both the inducing and the induced currents have their greatest values, while during the period of attraction the currents are of small amounts comparatively. This condition may be otherwise expressed by saying that the period during which repulsion occurs includes all the maxima of current, while the period of attraction includes no maxima. There is, then, a repulsion due to the summative effects of strong opposite currents for a lengthened period against an attraction due to the summative effects of weak currents of the same direction during a shortened period, the resultant effect being a greatly preponderating repulsion.

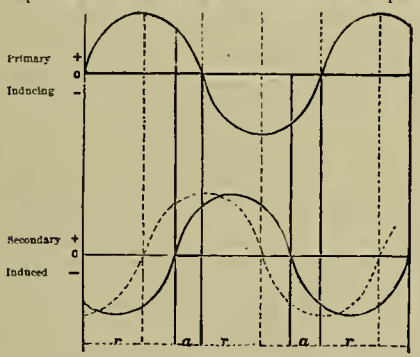


FIG. 23.

"It is now not difficult to understand all the actions before described, as obtained with the varied relations of coils, magnetic fields and closed circuits. It will be easily understood, also, that an alternating magnetic field is in all respects the same as an alternating current coil in producing repulsion on the closed conductor, because the repulsions between the two conductors are the result of magnetic repulsions arising from opposing fields produced by the coils when the currents are of opposite direction in them."

Electrical Exhibition at Frankfort.

Arrangements are making for an elaborate electrical exhibition at Frankfort-on-the-Main next year. Applications are on file from manufacturers of electrical apparatus in every country in Europe. A Zurich firm will display an electric boat capable of carrying 100 persons. Current will be furnished to operate the craft by accumulators. This boat, which will be artistically fitted and furnished of course with electric light, will ply on the River Main to serve as aid in the traffic between the interior of the city and the eastern part, where the exhibition will be situated. In view of the scope offered for the use of an electric boat service on the lakes in South Germany, Switzerland, and Austria, this part of the proposed exhibition will be regarded with especial interest. It is also understood that the Electro-Technical Society of Frankfort has decided to organize an international electrical congress at the time of the exhibition, at which numerous practical questions will be discussed.

Suits against the Chicago Telephone Co.

Charles and Albert Piper, the ice dealers, brought two suits last week in the Circuit court against the Chicago Telephone company. It is alleged that the employes of the defendant went on the land of the plaintiffs near Willow Springs, on the Chicago and Alton railroad, without permission and cut the branches from several trees while they were putting up a line. One suit is for $5,000 for trespassing on the land, and the other is for $3,000 for debt, and is brought under a statute which allows damages in similar cases.

Fort Wayne Electric Club.

The Fort Wayne, Ind., Electric club formally opened its handsome new parlors last week. The dedicatory exercises were of an elaborate character and befitting the occasion. A hundred incandescent lamps brilliantly illuminated the hall, which was tastefully trimmed, while on the stage there was a profusion of plants and cut flowers. An excellent orchestra furnished music, and speeches were made by the following named gentlemen: Hon. Robert S. Taylor, Prof. C. R. Dryer and M. M. M. Slattery. Charles C. Miller, who acted as master of ceremonies, said he was commissioned by R. T. McDonald to extend the assurance of his hearty support of the club, and express his regret that he was unable to attend. Mr. McDonald has been one of the most enthusiastic supporters of the club during the critical period of formation. The organization has begun well, and it will no doubt prove an important factor in electrical matters in Fort Wayne. The officers are: Chas. C. Miller, president; Harry McKinley, vice-president; Eugene McLachlin, secretary; Lewis Freyer, treasurer.

To these committees can be attributed the success of the dedicatory arrangements: Entertainment committee—John J. Kelly, F. S. Hunting, A. Hadden; reception committee—W. S. Hulse, Fred Keiker, Wallace Kendall, D. S. Meyers, D. C. Davis, A. B. Collier, R. F. Harding; floor managers—Harry McKinley, W. E. Jenkinson, T. W. Houlihan.

Carpenter Storage Battery.

The Carpenter Electric & Storage company of Denver, Colo., is putting a new form of storage battery plate on the market, which has thus far given excellent results in operation. These plates consist of red lead and metallic lead, the former being inclosed within the latter, the dry red lead being packed around numerous steel rods projecting through the metal casing. The case or envelope is then sealed by burning the joints with a hydrogen flame; the steel rods are withdrawn, leaving a solid plate of dry red lead, encased with metallic lead and perforated with numerous small holes. The plates are then placed in dilute sulphuric acid and charged. The change from the old method of pasting batteries under the Faure process, it is claimed, has proven successful. Under the present system the active matter is encased by metallic support, so the numerous perforations being uniform. Attention has heretofore been called to the experiments of this company in car lighting. It is lighting a chair car in daily service between Denver and Chicago over the Union Pacific and Northwestern roads. The car is equipped with sixty cells and ten 16-candle power Perkins lamps. The battery cases and trays weigh 1,600 pounds and have maintained the lights for over sixty nights, lighting the car four nights without recharging, and requiring no attention whatever. The battery can also be utilized for motor work and traction purposes. A motor is now in course of construction for street cars.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 7.—It would seem that electric traction is at last obtaining a footing in New York and vicinity and it is confidently expected that the time is not far distant when electricity will be the motive power on all the surface and elevated systems. The application of President Lewis of the Brooklyn City company for permission to substitute electricity for steam on the Third avenue line has been sent to the board of aldermen, and the company is preparing an application for permission to use electric traction on many of the lines in the heart of the city. The property owners readily acquiesce and have given permission along Fulton street, Flatbush avenue and Third avenue to use electricity. The Atlantic avenue company is also in the line of progress, and desire to substitute electricity for horse power. President Richardson has made an application to the city authorities for the change.

The Coney Island & Brooklyn company, whose overhead system of electric traction is giving perfect satisfaction, is anxious to extend the line. President Slocum has obtained permission of the Park Commissioners to rebuild the tracks of the Prospect Park and Flatbush line in Franklin and Ocean avenues. In order to make a better connection with the horse cars from the eastern district, permission was asked to rebuild the road around the circle where it crosses the Ocean Parkway, but Park Commissioners Brower and Luscomb objected on the ground of interfering with driving to and from the Park. General Slocum replied: "The mass of people who take horse cars to Coney Island deserve fully as much consideration as the men who drive spans of horses worth thousands of dollars. I may as well say that I shall soon apply for permission to run the electric cars across the circle at that point where the horse cars now run." Unless the legislature passes an act, President Brower said that he would never favor any motive power other than horses. Gen. Slocum replied that he would have to fall in line with progress whether he wanted to or not, arguing that "there are 150 cities now in the United States using electric cars, and they are run in Beacon street, Boston, and in New York avenue, Washington; and if they are good enough for these fine thoroughfares, they are good enough for Fifteenth street, the meanest street in Brooklyn."

The Jones bill fixing the price of gas in New York at $1.25 per 1,000 feet, in Brooklyn at $1.50, and in cities between 100,000 and 200,000 population at $2, has been signed by the governor, with the following memorandum attached: 'I have heretofore recommended the creation of a State Gas Commission (which also should include in its jurisdiction all telephone and electric light companies) to be invested with limited powers somewhat similar to those possessed by the railroad commission over railroads. I have approved during the past few years several bills regulating the price of gas in various cities, but more than once I have intimated my reluctance to approve any more such bills until such commissions should be created, by which the propriety of such measures might be carefully investigated and legislative action might be based upon the recommendations of such commission. The regulation of the price of gas as well as the charges for electric lights and telephones in different cities by legislative power is liable to abuse, and should only be exercised after proper investigation by a competent board. Corruption, prejudice, fickleness, unfairness or favoritism are too apt to characterize or accompany legislation upon such an important subject, particularly in the absence of a semi-judicial investigation of the conditions and circumstances which should naturally affect its determination. I am still impressed with the desirability of such a commission as I have suggested, and trust that another legislature may in its wisdom pass a carefully-guarded measure carrying out this recommendation to the end that the possibility of hasty, arbitrary or ill-considered legislation upon this subject may be avoided. The present bill, however, as I understand it, made very slight changes in existing prices and in the present statutes applicable to the various cities of the state; and as such changes seem to be in the right direction and reasonable, it is believed upon the whole that the public interest will be best subserved by approval of the measure."

The rapid transit commissioners, together with eminent engineers, have practically determined upon a route for an underground system. Mr. Steinway claims that if the Cable Railway bill becomes a law, the company will have no trouble in legally putting a road under the Park, and after a careful consideration of the bill, says that he does not see wherein it is not a safe measure, and how it interferes with the kind of rapid transit under discussion by the commission. The eminent English engineer, Jas. H. Greathead, sent a communication through his attorney to the commission in regard to the great Southwark tunnel now near completion in London. This tunnel is 3½ miles long, and is built from 40 to 60 feet below the surface, thus avoiding the network of sewers and conduits beneath the surface. The plans and description of the work are also furnished.

Articles of incorporation have been filed with the Secretary of State by Horace H. Farrier, Theodore L. Parker and Harry A. Parker of Jersey City for the purpose of operating a general messenger, police, fire, telegraph and electrical business in Hudson county. The new company is the American District Telegraph company, with a capital stock of $50,000. The service will extend through Jersey City, Hoboken, Bayonne, the townships of Kearney and Harrison, West Hoboken and Union Hills.

It is rumored that another elevated system is under headway, which will be a great improvement over the present structures. Electricity is to be the motive power, and all the disadvantages of noise, obstruction to light and air will be removed. A syndicate with unlimited capital is at the back of this scheme, and an exhibition of the working of the system is soon to take place.

The decision of Judge Underwood of Auburn, in the Kemmler habeas corpus, was affirmed last Tuesday by the General Term of the Supreme Court, and this allows the case to go at once to the Court of Appeals, which shall determine whether or not the warden of Auburn prison can legally execute Kemmler.

The assignee of certain English stockholders in the Electric Sugar company, in his suit to get back from treasurer Robertson $17,000 on the ground of false repre-

sentations, is again stirring up the electric sugar fraud. The trial now on before Judge Patterson brings to the light the claim that there was an electric refining process, the secret of which died with "Prof." Friend. W. H. T.

Kansas City, Mo.

KANSAS CITY, Mo., June 7.—The Inter-state Electric company assigned last week to William Allbrittain. The property consists of a number of cells of storage batteries, wires already put up and poles, office furniture and fixtures, machinery, consisting of two steam engines and five boilers, a franchise from this city, some electric lamps and electrical sundries and some accounts, a total valuation estimated at $9,000.

The Southwestern Electric Light & Power company has determined to issue bonds to the amount of $200,000 to run fifteen years at six per cent., secured upon the company's property. The plant is located at Joplin and the motor power to propel the dynamos is furnished by a waterfall about four miles from Joplin. Current for light and motors is already furnished by this company. It is determined to increase the facilities by the expenditure of the proceeds of the bonds and to supply the various mines in the vicinity with light and power.

T. F. Clohesey of this city has closed a contract to furnish the Jasper County Electric Power company with a 1,000-horse power plant. The Detroit Motor company furnishes the plant and 150 motors, ranging from five to twenty horse power, were included in the sale. The plant at Webb City will be placed in position and operation at once; 200-horse power will be in operation in thirty days, an additional 300-horse power in sixty days, and the balance in ninety days. The price of the plant is $78,000. The Jasper County Power company has a stock of $150,000, all paid up, and expects to have 2,000-horse power of motors in operation inside of a year. The company has a thirty years' franchise, and its officers are: Hon. W. P. Monroe, Nevada, president; Judge D. P. Stratton, Nevada, counsel; O. K. Caldwell, Nevada, treasurer; T. F. Clohesey, Kansas City, secretary and electrical engineer. The power will be distributed over a radius of one-half to three-quarters of a mile from the two cities and will be used in hoisting, ore crushing, pumping, jigging, tramming, etc. and furnishing light for the mines. Mr. Clohesey has left on a trip east for the purpose of purchasing ten 50-horse power generators and copper wire for the distributing system. A. A. Robinson of Detroit, general agent for the Detroit Electric Motor company, has returned home. He came to Kansas City to approve the contract made by T. F. Clohesey for the sale of electric motors and generators.

The Thomson-Houston Electric company has presented its Kansas City attorney, Delbert J. Haff, a fine office desk and chair. The present was made through the company's local manager, Charles S. Rusling.

Capt. William Brophy of Boston, was in the city last week. Captain Brophy is on a tour of inspection for the Electric Mutual Insurance company of Boston, of which he is chief inspector. He has been traveling over the country investigating the electric lighting stations with reference to construction, equipment and service. The captain has visited the largest stations in New York, Pennsylvania, Ohio, Illinois, Kansas, Michigan, Wisconsin, Iowa, Nebraska, New Jersey and Missouri. His trip has covered a period of nearly six weeks, and over fifty stations have been inspected. Besides representing the Electric Mutual Insurance company, he also represents eight electric companies.

The executive committee of the Missouri & Kansas Telephone company will meet here Tuesday, June 24, and the matter of new quarters for the company will come up for consideration.

The West Side Railway company of Kansas City, Kan., has been reorganized with E. D. Brown as president and A. R. Ford, vice-president, both of the city. Earnest work is now being prosecuted by the new company, and it is reported that operations will begin within thirty days. The new organization is backed up by a number of Eastern capitalists who will push the road to completion. An amending ordinance was introduced in the city council last week and laid over one week, allowing certain changes to be made in the route of the new road.

At the largely attended meeting of the Kansas City Electrical society last Friday night considerable interest was manifested in the report of the committee on drawing up an ordinance for the appointment of an electrical inspector. Copies of the ordinances under which the inspectors of other cities operate have been sent for, and the principa features of each will be used in framing the ordinance for Kansas City. It was declared the desire of the society that the committee, besides drawing up and presenting the ordinance, urge upon the mayor the selection of a practical, capable electrician, one who is of the highest integrity and common sense, a wire puller in an electrical sense, but not in a political one. Objection was made by the society to the reports that the Barrett-Hale fire alarm system was complicated—the society thinking it very simple and effective.

In reorganizing, the society has not forgotten the social side of the organization, but decided to set apart nights for social meetings. "Edison's Inventions" was the subject of an interesting talk by T. F. Clohesey. He described in particular the phonograph, quadruplex telegraphy and incandescent lighting. The remainder of the evening was occupied by a general discussion of electrical troubles or disturbances on telephone and telegraph wires. After the society adjourned the members visited in a body the telephone exchange and the home telegraph offices, on the invitations of Superintendents Smith and Barron. P.

St. Joseph, Mo.

ST. JOSEPH, Mo., June 9.—President Van Brunt of the People's line, was last week asked for a statement about the company's alleged efforts to secure an extension of franchise. He said: "The franchises asked for expire July 8th. We have made no application to the county court for an extension of time, nor do we contemplate making such application. No such application will be made. We have ample time between now and the limit named in the franchise to do the work of construction. The line to South Park has been constructed, and the other two will be, according to the franchise. The ties for the extensions are cut and piled, ready for shipment within 24 hours."

The only application made by the People's Railway company, now before the courts, is a petition for a right of way for an extension to Lake Contrary. It will be granted and the work will begin immediately.

The street lighting committee of the common council is struggling with an important piece of work just now. It has been generally supposed that the engines at the electric light power house were of sufficient capacity to operate forty or fifty more lights, if necessary, without any difficulty. But Superintendent Stewart assured them that, while the engines could be made to operate thirty more lamps by the use of another belt, it would be straining them to a dangerous point, and it would be more advisable to put in a third engine. It was also ascertained that, while one of the engines could at a pinch operate all the lamps now up in case of accident to either engine, the addition of more lights to the circuits would necessitate the cutting off of one or more circuits in case an engine had become disabled. The cost of putting in thirty more lights would entail a first cost of between $6,000 and $8,000, and a subsequent cost of about $1,500 a year. The committee received estimates from Mr. Hoagland, manager of the Globe Street Lamp company, who offered to put in 400 lamps, bearing all the cost of putting in the same, and take care of the lamps after they had been put in at an annual cost of $7,500. In order to put more machinery into the power house, it would be necessary to enlarge that structure. The committee has about come to the conclusion that to put in 30 more electric lights would scarcely pay when the cost and the amount of light to be obtained was taken into consideration. In consequence, Mr. Hoagland's offer is receiving favorable consideration, and will so be reported to the council, so that residents of South Park, Wyatt Park and Walker's addition, who have been clamoring for light, will get it in the shape of gasoline lamps. R.

Milwaukee, Wis.

MILWAUKEE, Wis., June 7.—There is just a possibility that the city will buy out the Badger Electric Light company and use the company's plant as the nucleus of a municipal lighting system. The matter is pending, in a way, before the common council. The committee on street lights, at the meeting last evening, recommended the passage of a resolution instructing the city attorney to draw up a bill as soon as possible, and present it to the aldermen for approval, to empower the city to issue bonds in the sum of $600,000 for the purpose of purchasing the Badger plant and maintaining it as a municipal system. Manager Wall, of the Badger company, has offered the plant to the city for $400,000, a large portion of which sum represents the value of the franchise granted to the company by the city. However, the limit of the city's bonded indebtedness is nearly reached, and it is not very likely that the legislature will increase the limit for some little time. The report of the committee was laid over.

For some time there has been considerable agitation in Milwaukee over the project of establishing a municipal lighting system. About two months ago the Board of Public Works, in accordance with a resolution of the common council, made an estimate of the cost of converting the abandoned water pumping works on Chestnut street in to an electric lighting plant. The idea was to furnish street lights for a portion of the West Side. The cost was estimated at $40,000, it being intended to start on a small scale, and increase the plant by expending from $25,000 to $30,000 a year. That proposition was buried. Then the Board of Public Works made an estimate of the cost of a plant that would furnish light for all the streets in the city. The cost would exceed $500,000 according to the estimate, and instead of carrying out that idea the plan of purchasing the Badger plant was originated.

Twice within less than a week telephone wires have fallen upon the unguarded trolley wires of the Hinsey road, the result being great excitement and some little damage at the telephone exchange.

The Wisconsin Telephone company's cable house on Third street, was set on fire, and a cable containing 200 wires was melted. The pecuniary loss is not great, but each time the telephone service has been injured in a portion of the city.

The Hinsey representation has finally secured a controlling interest in the Milwaukee & Whitefish Bay railway and will convert it into an electric road.

It is now quite likely that Hinsey will build his East Side and North avenue lines this year. It is understood that he paid for stock in the Whitefish Bay line with Milwaukee City electric railway stock, so that the deal virtually amounts to a consolidation.

City Attorney Austin has decided that the city has no control over the erection of telephone and telegraph poles on the streets and alleys, and can only secure the removal of any of them by formally declaring them public nuisances. He intimates that the common council may have exceeded its power repeatedly by granting railway and electric light franchises.

The National Home & North Greenfield Railway company, the new suburban road, has formally requested the common council for authority to build lines on the East, West and South sides. The company, if it carries out its plans, will build about twenty miles of road. The fight between it and the Milwaukee City Railroad company for a franchise to build on that part of National avenue west of the city, has already begun. The latter company has organized an independent corporation and is seeking the franchise. Its intention is said to be to charge an extra fare to the Soldiers' Home.

The West Side Railway company is preparing to extend its lines on Washington avenue. P.

Pittsburg, Pa.

PITTSBURG, Pa., June 7.—The directors of the Westinghouse Electric company held a special meeting in the Westinghouse building, this city, June 4, and passed the resolutions to the effect that a meeting of stock-holders be held on July 8 to transfer the business of the Westinghouse Electric company to the Westinghouse Electric & Manufacturing company; and to vote for or against the increase of the capital stock of the company.

It was also learned that at this meeting all of the regular stock of the Westinghouse Electric company was transferred to the Westinghouse Electric & Manufacturing company, so that at the time of the meeting merely formal action may be taken. The aggregate sales of the Westinghouse Electric company and its leased companies amounted to $4,362,000 in the year 1889, and for the first three months of this year in the lighting business alone, the increase over the same period of last year was about 80 per cent. Beginning with the month of May, the company has taken orders for the supply of railway equipment, and contracts have already been closed during the one month for upward of $200,000 of material, with negotiations well advanced for more than four times that amount.

The Duquesne Traction company of this city has been in the courts twice during the last week. The first case arose out of a suit brought against the company by the Pittsburg Traction company which claimed that the defendant company had taken possession of certain streets and started to lay tracks thereon, when in reality the right of way did not belong to it but to the plaintiff. This case was argued before Judge Paxon of the Supreme court in Harrisburg last Wednesday, June 4, and the defendant company came out of the struggle victorious. The other suit involved the question whether the Duquesne Traction company had any right to tear up Hiland avenue. The plaintiffs in this case were a large number of the residents of that street, who petitioned Judge White of this city to prevent the construction of the road. The judge granted the plaintiffs a preliminary injunction pending the hearing of the case, which is to take place within a few days.

The Troy Hill Electric Railway company is a new corporation which has only lately been organized for the purpose of building an electric road in Allegheny City and several adjacent boroughs. This enterprise involves a

large and comprehensive system of a railway circuit which will cover fifteen miles of track. So far the preliminaries have only been arranged, but as soon as the necessary privileges have been granted by councils, the construction of the road will be commenced.

Business is booming with the St. Clair Electric Railway company of this city. To the end that its patrons may be properly accommodated, that company has just placed several new cars upon its lines.

An interesting address was delivered in the rooms of the National Association of Stationary Engineers the other evening by James Hunter of the Allegheny County Light company. The theme of Mr. Hunter's talk was "The alternating current system for incandescent and arc lighting and the direct current for motor service."

Some Pittsburg capitalists are asking for rights to lay a street railway from Braddock, ten miles distant from Pittsburg, to Wilmerding, the new Westinghouse Air Brake town, five miles beyond. The matter is now before the councils of Braddock. Electricity will be the motive power in case the road is built. E. H. H.

THE ELECTRIC LIGHT.

The Central Electric company of Sacramento, Cal., has petitioned for an extension of time in which to complete its system.

Clower & Harris of Dallas, Tex., have just sold to the Wasahachie, Tex., Electric Light company a Heisler plant of a capacity of 250 32-candle power lamps

A company recently formed in Oregon, Ill., has placed an order with the Westinghouse Electric company for a 500 light alternate current incandescent dynamo.

The proposition to put in electric lights was defeated in Cameron, Neb., last week by a vote of 170 for and 156 against, a two-thirds majority being required to carry the proposition.

The Apollo Iron & Steel company of Apollo, Pa., has decided to illuminate its works by electricity. The new arc lighting system of the Westinghouse Electric company will be used.

The Westinghouse Electric company is about to ship to Moundsville, W. Va., a 500 light alternate current incandescent dynamo to fill a recently received order from a new lighting company there.

The Oakland, Cal., trustees have granted a new franchise to the electric light and power company of that place. The Edison company has also been granted a franchise for an underground conduit.

The Peoria, Ill., Gas & Electric Light company has been incorporated to operate a gas and electric light plant; capital stock, $750,000; incorporators, F. C. Crowley, Marion Pickett, W. C. Boune.

The Quincy, Ill., Gas & Electric Light company has been incorporated to construct and operate an electric light plant; capital stock, $400,000; incorporators, F. C. Crowley, W. C. Boune and Marion Pickett.

Lebanon, Mo., voted on the electric light proposition last week, and the result is in favor of the electric light. There was a heavy vote cast, and only four against it. The franchise was granted to B. F. Hobart and associates, St. Louis capitalists, who have bought all the property and interests of the Lebanon company.

A Milwaukee correspondent writes: John A. Hinsey has purchased the Badger electric light plant in this city. The terms of sale and the consideration are private, and Mr. Hinsey refuses to talk about the matter further than to say that he considered that the plant was a good investment, and that while he was in the electric business he might as well be in it all over.

Among the recent sales of J. H. Reid, manager of the Chicago office of the Mather company, are the following: New Broadway theater and Bush apartment house, Denver, 1,600 incandescent and 10 arc; Windsor Hotel, Denver, 900 incandescent and 20 arc; Eureka, Kan., 500 incandescent; Liberty, Mo., 200 incandescent; Kansas City, Mo., 400 incandescent; Webster City, Iowa, incandescent plant as follows: 400 commercial lights, 89 32-candle power lights and 400 lights for residences.

THE ELECTRIC MOTOR.

The Rapid Transit company of Salt Lake City has purchased a site for a power house, and will build immediately. The lines now in course of construction will soon be finished, and in a short time, it is expected, there will be fifteen cars in operation.

The Syracuse Consolidated Street Railroad company has filed articles of incorporation with the secretary of state at Albany, N. Y. The road is to run through Syracuse and the towns of Geddes and Onondaga. The road is to be 40 miles in length and to run over nearly all the principal streets. The road will probably be run by electricity. The capital is $1,250,000.

A Galveston, Tex., paper says: There are now in the city representatives of three electric motor companies in conference with the Galveston Railway company, with a view to introducing electric motors on the street railway. These gentlemen are here in answer to a summons of the City Railway company, which recently decided to substitute electric motors for horses.

Judge D. C. Metsker of Topeka, Kan., at the head of the Sedalia, Mo., Electric Railway company, states that the railway in the latter city will be in operation by the 19th of June, and he has fixed upon that date for the excursion from Topeka to Sedalia. A special train, via the Rock Island & Missouri Pacific, will leave Topeka on the morning of June 19th, conveying prominent capitalists from various parts of the west.

According to a St. Louis paper Thomas T. Eckert, vice-president of the Western Union Telegraph company, and R. C. Clowry, M. C. Bristol and F. J. Scherrer of Chicago, were in that city looking for a suitable building in which to establish permanent local quarters. Vice-President Eckert said: "We have not yet fully decided where the office will be located. We are here looking over the field and making an examination of several buildings. The matter will be settled in a day or two."

Last week clearly demonstrated the ability of the electric system of street car propulsion to take care of enormous loads In the cities the amount of travel imposed upon the electric cars was far in excess of that for which they were intended but in spite of the enormous loads carried in each case the operation of the cars was successful in every particular. At Cleveland on May 30 occurred the ceremonies connected with the dedication of the Garfield Memorial and the city was crowded with strangers who took the electric cars to the park. The greater part of these people were carried by the Sprague electric cars on the East Cleveland Street railway though many passed over the line of the other two street railways in Cleveland. The cars on all three lines were crowded with passengers. Many of the cars ran trailers, and both motor car and trailer were taxed to their utmost capacity. In Buffalo on the following Sunday the four electric cars in operation on the Buffalo Street railway ran all day long, drawing one or two trailers each, and are credited with carrying in all over 15,000 passengers. It is said that the managers of the roads in both of these cities are very enthusiastic over the operation of the cars, and the press of the city has spoken in the highest terms of the performance under the most trying conditions.

The ordinance granting the Topeka City Railway company the right to operate its lines by electricity was taken up at the last council meeting, and its consideration called out the usual debate upon the section relating to the occupation of the tracks from Second street to Gordon street by the Topeka City Railway company and the Rapid Transit company. After an hour's debate the section was passed, providing for joint occupancy and use of the track by a vote of 7 to 3. The franchise provides that the cars are not to run more than three miles an hour over the bridge, and they are not to be moved by any power but horses until the new bridge is built. The company is to pay one-third of the cost of re-flooring the present bridge and of keeping it in repair generally. Any other company to which the council may grant a franchise shall have the same right to run over the tracks of the city railway, and use its trolley wire from Second street to Gordon street, the lines are to be consolidated as far as their differing gauges will allow for that distance; a third rail will have to be put down for the rapid transit. The compensation any other company using the Topeka City Railway company's tracks shall pay to the latter may be settled between them; if they cannot agree, the mayor and council are to decide it. The city railway must accept the franchise within thirty days, pay $2,500 to the city treasurer, and have the road equipped with electricity within six months thereafter. The company is to light Kansas avenue with electricity from Tenth to Gordon.

The Thomson-Houston Motor company of Boston has put in operation an electric coal cutting machine which has attracted attention from mining men throughout the country. The machine is in practical operation near Osceola, Pa. The plant consists of a 7-horse power steam engine belted direct to a 7-horse power generator. The electric current is conveyed through the mine to the coal cutter, by a wire suspended along the roofs of the chambers. The cutter in this case is nearly a mile from the generating plant. A 5-horse power motor operates it and is compactly placed on the same bed plate with the machine. The cutter itself consists of an iron frame 24 inches high, 8 feet 6 inches long, and 30 inches wide. Nine auger shaped drills similar to those now used in mining are placed in the lower part of the frame. Between each drill is a steel cutter bar which cuts all coal left between the holes drilled by the auger bits. On the under side of each cutter bar are attached several scrapers which hang loosely and pull all the coal back as fast as it is cut or drilled, keeping it out of the way and making the opening clear. All coal taken out of this cut is coarse and none is wasted. The height of the cut is 4 inches. The machine makes two cuts in five minutes, as it is easily handled, and needs only to be pushed along the breast by lever bars. The switches and controlling devices are so placed that one man easily operates the cutter. The machine is provided with twin wire cable which is long enough to extend along any ordinary chamber and does away with the need of permanent wiring except in the headings. A suitable truck is provided for the cutter upon which it may be carried about the mine with ease. An ingenious device will be provided on future machines, by means of which the motor will pull itself and the cutter off and on the track as required. The weight of the complete machine is a little over one half a ton. One strong point in favor of this machine is the readiness with which it accommodates itself to varying hardness of strata. The motors are wound for 220 volts' pressure. The capacity of the machine is 180 tons of coal per day of ten hours in a 4-foot vein. Several improvements on the first machine will be embodied in the regular apparatus which is now being manufactured at the Thomson-Houston Motor company's factories at Lynn, Mass.

A St. Paul paper says in regard to the electric railway work in Minneapolis: "The impression prevails quite generally among those who have taken special interest in street railway matters in Minneapolis (and that includes about every taxpayer in the city) that the work of putting in the new lines, or of getting ready to put them in, is progressing rather slowly, and that the contemplated improvements will not be completed anywhere near as early as was at first expected. While Mr. Lowry did not make any very definite promises as to when the new lines would be running, he did say some of the lines would be in operation by July 1st. This was the date which patrons of the motor and Washington avenue lines had in mind. It is evident the work is more extensive and the processes of reconstruction less speedy than Mr. Lowry and his associates had any idea of. There has been quite a serious delay in the shipment of wire and some other material, and the delay in the work is due in large measure to that. The wire is now coming in good shape, and General Manager Goodrich is well pleased with the way things are going. The power plant ought to be in by July 1st. The first engine may not be here before that time, however. It will take two or three weeks to put the engine up. It can be made to run at a capacity of about 1,500 horse power. The work of lowering the railroad tracks at Fourth avenue north will possibly be begun the latter part of this week. The laying of the tracks will be done as quickly as possible, of course. The idea is to close all the thoroughfares affected by these improvements, and to drive all the travel and traffic to Washington avenue while the lowering and bridging is being done. It is proposed to construct a couple of temporary bridges at the Washington avenue crossing. These 'false works' will be on the other side of the avenue, and so constructed as not to interfere with the work of building the permanent bridge at that point. The street cars could pass on one of these temporary bridges. The closing up of Third, Fourth and Fifth streets will of course concentrate a tremendous traffic at the Washington avenue crossing, but the inconvenience will not last long when the work gets well under way." A Minneapolis paper, in commenting on the criticism, says: "The street railway people naturally did not take kindly to this criticism, because the work is being pushed as rapidly as possible, and while Engineer Clift Wise did not care to make any predictions, he said that the work would be completed in the required time. About July 1st the motors will be taken off the First avenue line, and from then until about August 1st the patrons of that line will be compelled to use the Fourth avenue electric line to Thirty-first street. The change from steam to electricity will occupy about a month."

THE TELEGRAPH.

The Postal Telegraph Cable company has increased the number of its directors by placing John W. McKay of Virginia City, Nev.; James W. Ellsworth of Chicago and William C. Van Horne and Charles Hosmer on the board. The other directors are George S. Coe, A. B. Chandler, Hector De Castro, John O. Stevens, William H. Baker, Edward C. Platt and George G. Ward.

A cablegram says: The International Telegraph Conference in session at Paris has rejected the proposal to increase from three to five, the number of figures now charged for as one word by the cable companies.

THE TELEPHONE.

The Metropolitan Bell Telephone company, says the New York *World*, has just completed arrangements for the benefit of the girls in its employ. A large sunny sitting-room has been provided, with wide windows, affording lovely river and harbor views. Turkish rugs cover the floor and lounges and rocking-chairs invite repose Three large tables are laden with cups, saucers, plates, spoons, sugar and milk, while behind two immense urns stands a woman supplying tea and coffee to those who wish either All this is free. Besides the noon hour each operator has two recesses a day known as "reliefs."

One portion of the dressing room is divided into lockers, every girl having one to herself. All this is in sharp contrast to the semi-dark basement, the rows of pegs, with dangling hats and sacks, and the lunches eaten from brown paper bags and swallowed in conjunction with close air and tepid water, with which most working girls are familiar.

Electrical concerns have had thus far little trouble with employes, but it is hardly necessary to point out that such treatment as this serves as a good antidote for strikes.

Miscellaneous Notes.

Lightning played havoc throughout the country last week. There were electrical storms in all sections of the country and great damage was done, though in no particular instance was the loss very great.

The Illinois Electric Transmitter company of Chicago was incorporated last week to manufacture electric transmitters; capital stock, $1,000,000; incorporators, William F. Sherman, William S. Brewster and Stephen P. Gardner.

The Sacramento, Cal., Electric Construction company has applied to the trustees for an underground conduit franchise for electric wires. It is proposed to rent out the conduit, and to furnish the city free use for telephone, fire alarm wires, etc Work will be begun at once if the franchise can be secured.

Ciel et Terre mentions an Italian precursor to Franklin, a doctor of the name of Ignario, who in 1746, at Padua, produced a book on "Electricity and the Electric Force of the Body." In this volume he describes the effect of the Leyden jar, and says: "Who shall deny that lightning is other than a subtle electric matter carried to the greatest degree of force? What fatal surprise would await the experimenter who, having found the artificial means of producing lightning should succumb a victim to his curiosity?"

Articles of incorporation have been filed by the American District Telegraph company of Minnesota. The principal office of business will be located in Duluth, and the capital stock is $50,000. It is the purpose of the concern to build telephone and telegraph lines, pneumatic tubes and

other accessories to a general message transmitting business. The incorporators are Henry C. Hope, Wm. H. S Wright, James B. King, Samuel B. McConnell, Samuel Dearing, Salon L. Perrin, of St. Paul, and Geo. C. Howe, of Duluth.

An enterprising wine merchant of Paris has made his fifth capture of burglars under the following circumstances. There is no porter for his premises, so he has caused his shop to be connected by means of an electric wire with the room occupied by his waiters. When the burglars enter, an electric bell rings in the waiters' room and they are thus warned of the entrance of the thieves. The wine merchant's experiment it is said has been so successful that several other traders in the vicinity have adopted the same scheme.

A correspondent of an English exchange writes that an officer on board the German ironclad "Preussen," in conjunction with the engineer of that ship, has invented an electrical steering apparatus about which there is much talk just now in naval circles. By means of this apparatus the captain can control the rudder from the bridge or from any point on the deck—an important advantage in the noise of a storm or in action. That the invention is regarded by the authorities as one likely to prove of great importance is shown by the fact that the ironclad "Koenig Wilhelm," on the very next day after her return with the Mediterranean Squadron, was sent to sea to test it.

Personal Mention.

Walter K. Freeman of New York City was in Chicago last week.

J. Elliott Smith, superintendent of the fire alarm and telegraph service of New York city, was in Chicago last week.

Business Mention.

The Fitch Battery & Electric company having moved into its new factory its address in the future will be Oneida, N. Y.

Cleverly, of Philadelphia, is alive to the situation, and sends his numerous friends useful compliments of the season in the shape of handsome blotters.

The United Edison Manufacturing company has just issued a handsome pamphlet illustrative of the Edison electric light system. It is compiled with more than ordinary care, and gives an interesting account of the operation of plants.

Chadbourne, Hazelton & Co., Philadelphia, Pa., have issued a neat circular describing the electrical apparatus of the Wenstrom Consolidated Dynamo & Motor company of Baltimore, Md., of which they are agents. Both concerns are favorably known in electrical circles.

Electric tramways in mills and factories have grown in favor during the last year to such an extent that the manufacturers of electrical apparatus are giving this subject considerable attention. The Thomson-Houston company has just issued a circular descriptive of its system which will interest mill owners.

W. R. Molinard of the Baxter Electric Motor company has been passing the last three or four weeks in the vicinity of Chicago working up this territory in the interest of this company He has succeeded in establishing a number of agencies in which he has enlisted the services of active and energetic men. Mr. Molinard feels highly elated at his success so far, and is enthusiastic over the prospects for the future. The Baxter company is very well pleased with the way in which business has been increasing in this section, particularly with the arc motor.

The fact has already been mentioned in the WESTERN ELECTRICIAN that the John A. Roebling's Sons company of 173 Lake street, Chicago, received the big wire order, amounting to $250,000, from the Minneapolis Street Railway company. This was probably the largest single wire order ever given by an electric company, but it seems that even that did not cover the entire amount of wire required, as this same company has just been favored with another order for $60,000. These two sales amounted to over $300,000. The Roeblings are certainly to be congratulated on such a handsome sale.

The Electric Merchandise company of 11 Adams street, Chicago, writes as follows: "We have purchased the merchandise business of the Sprague Electric Equipment company, and shall carry on the same at the above address. We shall continue to manufacture appliances of all kinds for use by electric railways, irrespective of system used, and shall carry a large assortment and complete stock of all devices used by the respective systems in station, car or line work. We have in process of manufacture many improvements in car fittings, line material, etc. It will be our earnest endeavor to have the very best material in the market at the lowest price and guarantee promptness in delivery. Our catalogue and discount sheet will be mailed on application." W. R Mason is general manager of the company.

The Taylor Manufacturing company, of Chambersburg, Pa., reports sales of the Beck automatic engines within the last few weeks to the following: Reeds Lake Electric Railway company, of Grand Rapids, Mich., for electrical railway service; Norfolk & Western Railroad company, Roanoke, Va.; South Baltimore Foundry company, Curtis Bay, Md.; Citizens Electric Light & Power company, of Lansdowne, Pa.; Tiffin, Ohio, Edison Electric Illuminating company,; H. A. & T. C. Gooch, Louisville, Ky., (second order); Virginia Electric Light & Power company, Richmond, Va.; J. M. Badger, St. Paul, Minn.; Cedartown, Ga., Ball Electric Light company; Sears' Building, Boston, Mass.; Read & Hovalt, Weatherley, Pa.; P. E. Blalack, Newton, Miss.; Elephant Club, Brooklyn, N. Y.; Steamer Grand Republic, New York City; Luehrmann Hotel, Memphis, Tenn.; Scottdale Electric Light & Power company, Scottdale, Pa.

It is stated by the United Edison Manufacturing company it would appear that the electric light business in isolated plants and small central stations continues to grow in a very marked and satisfactory manner. The increase on the sales of dynamos by the cash installation division of the United Edison Manufacturing company during the month of April this year shows 204 per cent. more than for the corresponding month in 1889, together with a greater percentage of lamp capacity of the dynamos. The dynamos have been installed in all parts of the Union, from the Golden Gate City to small villages in Maine; from New Orleans, the Queen City of the Gulf of Mexico, to the newly settled districts in the far Northwestern territories. The lamp sales have also vastly increased; the percentage of increase for the month of April being 116 per cent. more than for the corresponding period last year, showing that the policy of the company in mounting Edison lamps with bases to fit the various sockets that are in use, thus enabling consumers operating plants other than the Edison to employ the Edison lamp, has been a wise one. The United Edison Manufacturing company for the past eight months has been gradually getting its business in shape to attend to all construction itself and to supply plants with the various materials they need. All construction work for the Edison system throughout the United States and Canada is now done by the company itself under a very comprehensively organized construction force. The company has also established a depot of supplies in Chicago, Denver, San Francisco and Canada, in addition to a New York depot, and now carry in each one of these localities a complete stock of dynamos, lamps, sockets, switches, cutouts, wire of all various makes, in fact, all materials which are used in connection with electric light and power plants. This arrangement is proving extremely satisfactory to the purchasers and owners of Edison plants, as the company is now enabled to install a plant upon short notice and is able to furnish any supplies required immediately from stock at a short distance from the purchaser. It has been accepted generally by the electric light companies that the summer months show an unusual falling off both in regard to lamp sales and installations. But from the amount of business that is being done and the orders that are being placed with this company there will be an exception to the rule this summer at least, as far as the Edison company is concerned.

Electrical Patents.

Issued June 3, 1890.

429,107. Electro Magnetic Locomotive. Richard N. Allen, Cleveland, O.

The aim of the invention is, primarily, to provide a practical and efficient means for imparting the motion of the motor to the driving wheels, and for protecting the motor from the effects of dust and exposure to the weather.

429,109. Apparatus for Rectifying Electric Currents. Frank Anderson, Peekskill, N. Y.

The invention relates, generically, to procuring in two electric circuits, one of which is auxiliary to the other, of two alternating electric currents, with any required difference of phase of undulation of each current relatively to the other.

429,113. Trolley Carrier. Benjamin F. Brown, Boston, Mass.

429,115. Printing Telegraph. John Burry, Boston, Mass.

Of the nineteen claims the sixteenth follows:

"The combination, in a transmitter for a printing telegraph, of key levers, sunflowers controlling the circuits governed by said key levers, and a stop lever adapted to be forced by said key levers in the path of a moving part of said sunflowers."

429,129. Magneto Telephone. Noel B Ginochio, New York, N. Y.

429,133. Fuse Box. Carl E. Kammeyer, Eau Claire, Wis.

429,172. Portable Electric Lamp. John H Irwin, Morton, Pa.

429,189. Indicator for Elevators. John P. Cushing, Boston, Mass.

429,199. Electric Railway System. William D. Mac Questen, New York, N. Y.

429,233. Multiple Telegraphy. Edward N Dickerson, Jr., New York, N. Y.

429,251. Cover for Electric Subways. John Stafford, New York, N. Y.

429,255. Machine for Covering Cables. James D. Bishop, New York, N. Y.

429,272. Electrode for Secondary Batteries. Carl Hering, Philadelphia, Pa.

429,273. Secondary Battery. Carl Hering, Philadelphia, Pa.

429,274. Electrode for Secondary Batteries. Carl Hering, Philadelphia, Pa.

429,277. Electric Tramway and Car. Alexander L. Lineff, Chiswick, County of Middlesex, England.

429,286. Apparatus for Detecting Leaks in Pipes. William W. Rosenfield, Brooklyn, N. Y.

429,304. Electric Conductor. Henry B. Cobb, Wilmington, Del.

429,305. Electric Conductor. Henry B. Cobb, Wilmington, Del.

429,306. Joint for Electric Conductors. Henry B Cobb, Wilmington, Del.

The method consists in bringing together and securing the ends of the wire, inclosing the said connected ends in insulating material, and inclosing the joint thus partly formed in metal.

429,307. Underground Conduit for Electric Wires. Henry B. Cobb, Wilmington, Del.

429,314. Continuously Operated Electric Motor. William D. MacQuesten, New York, N. Y.

429,315. Insulator for Electric Railways. William D. MacQuesten, New York, N. Y.

429,316. Tension Bracket for Trolley Wires. William D. MacQuesten, New York, N. Y.

429,318. Electric Fire Alarm and Extinguishing Apparatus. Charles E. Ongley, Yonkers, N. Y.

The invention is especially designed for the protection of buildings, such as factories and hotels, and this is accomplished by placing different signal boxes in various parts of the building, so that if a fire occurs at any place one of the boxes will be released and the number of the box will be signaled at the office of the building or elsewhere.

429,327. Electric Railway Motor. Frank J. Sprague, New York, N. Y.

The invention comprises a wheeled truck or vehicle having an equalizing bar extending from one movable axle box to another, of an electric motor carried by such equalizing bar, and having its armature shaft mechanically connected with an axle of the vehicle.

429,330. Electric Call and Voting Apparatus. Turney M. Wilkins, Miller, S. D , and Axel H. Reed, Glencoe, Minn.

429,333. Process of Maintaining a Uniform Current in Electric Circuits. Julien M. Bradford, Portland, Me.

The method consists in causing two or more regulating devices or other compensating agents to act accumulatively, each with a progressively increasing effect the instant the current varies, either by increase or decrease.

429,360. Watchman's Time Recorder. James F. McLaughlin, Philadelphia, Pa.

429,377. Telegraphy. Shirley M. English, New Orleans, La

429,386 Process of Separating Metallic Impurities from Graphite. Myron W. Parrish, Detroit, Mich.

429,396. Electrical Clock Winding Mechanism. Charles A. Ward, Waterbury, Conn.

429,413. Trolley for Electric Railways. Warren S. Blauvelt, Asbury Park, N. J.

429,447. Medical Battery. Franklin P. Hoeneman and William A. Hoeneman, New York, N. Y.

429,478. Interlocking Electric Railway System. Joseph Ramsey, Jr., and Frederic C. Weir, Cincinnati, O.

429,483. Electric Railway Signaling Apparatus. Chas. H. Rudd, Evanston, Ill.

The objects of the invention are not only to enable the engineer to control the train from the main station, but also automatically to indicate the speed and location of the train to him at that point. These ends are attained by using a three-rail track or way, each properly insulated in well known ways, one of which rails constitutes a conductor for the actuating or direct current which passes through the motor and returns to the generator through the other two rails upon which the supporting wheels of the locomotive respectively run.

429,490. Field Magnet for Dynamos. Edmund Wagemann, Little Rock, Ark.

429,534. Manufacture of Carbon Filaments. Achilles de Khotinsky, Geinhausen, Prussia, Germany.

429,535. Manufacture of Carbon Filaments. Achilles de Khotinsky, Geinhausen, Prussia, Germany.

429,559. Electric Heating Apparatus. Charles E. Carpenter, Minneapolis, Minn

429,560. Electric Heating Apparatus. Charles E. Carpenter, Minneapolis, Minn.

Claim one reads as follows:

"In an electro-heating apparatus, the combination, with an internal layer or card of incombustible electrical insulating material and resistances lying on one or both faces thereof, of a layer of electrical insulating material covering each of said resistances and exterior heating surface plates."

429,561. Electric Soldering Iron. Charles E. Carpenter, Minneapolis, Minn.

429,562. Method of Electric Heating. Charles E. Carpenter, Minneapolis, Minn.

429,573. Electric Arc Lamp. Chauncey F. Keller, Lima, Ohio.

"Claim 1: In an electric lamp, the combination, with electro magnets, movable core, and a pivoted frame having loose connection with the core, of a spring bearing on each side of the pivoted frame, and thumb-nuts or equivalent devices for regulating the tension of the springs."

429,576. Printing Telegraph. Andrew T. McCoy, Boston, Mass.

429,577. Printing Telegraph. Andrew T. McCoy, Boston, Mass.

429,582. Electric Railway Signal. Homer A. Parrish, Jackson, Mich.

429,583. Electrical Converter. Gustav Pfannkuche, Cleveland, O.

The last claim is given:

"3 In a converter, the combination, with a core provided with ventilating spaces extending transversely through it, of a secondary coil encircling the core, and insulating corner pads for forming ventilating spaces between the core and secondary coil."

429,584. Fuse Box. Nathan S. Possons, Cleveland, O.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

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ELECTRIC LIGHT WIRE,

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THE "CLARK" WIRE.

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In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: "**A Thoroughly Reliable and Desirable Wire in Every Respect.**"

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Published by authority of the Common Council of the city of Milwaukee.

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Such lighting, wiring and all other work necessary thereto to be done under the regulation of such ordinances and resolutions as have been or may hereafter be passed by the common council of the city of Milwaukee.

All bids must specify the kind of light to be furnished, and must be accompanied by a good and satisfactory bond in the penal sum of $50,000.00, approved as to form and execution by the city attorney.

All bids received will be submitted to the common council for consideration.

All bids must be stated in writing and in figures.

Signed, G. H. BENZENBERG, W. P. O'CONNOR, GEO. P. TRAEUMER, GARRETT DUNCK, Commissioners of Public Works.

Counte signed May 20, 1890.

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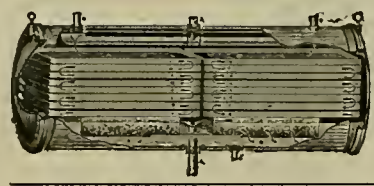

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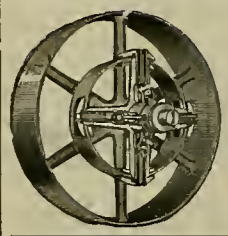

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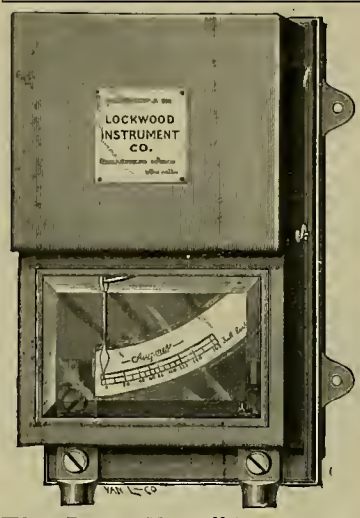

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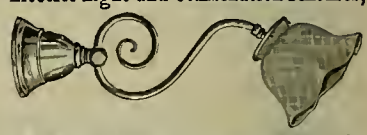

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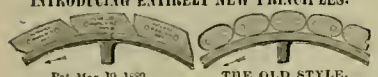

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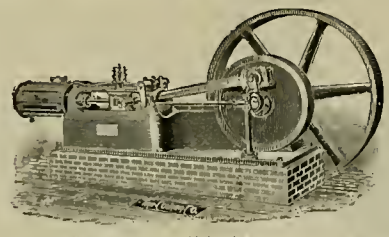

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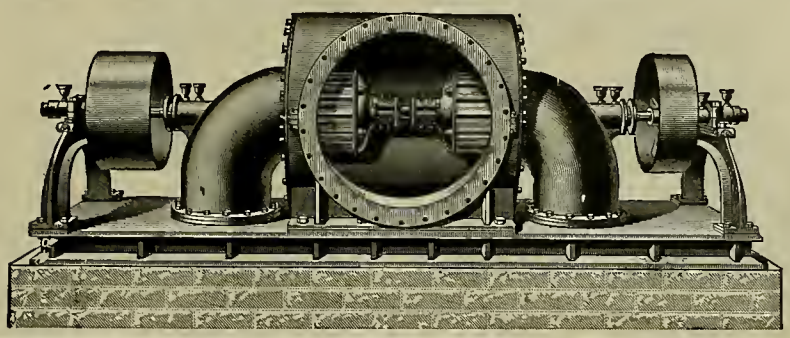

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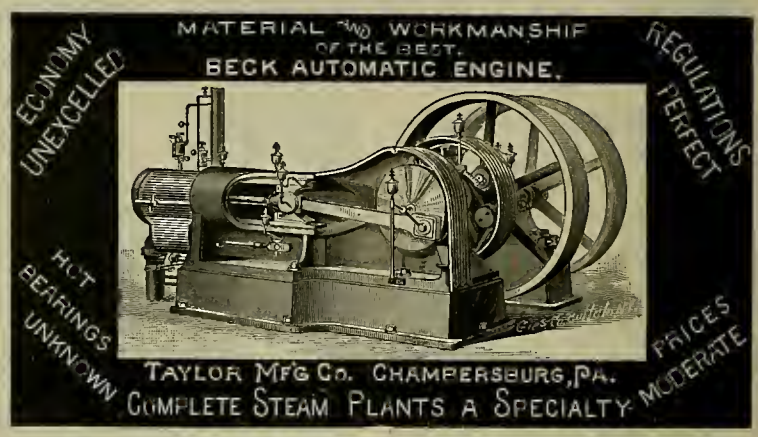

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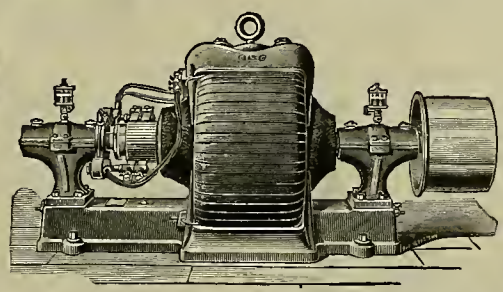

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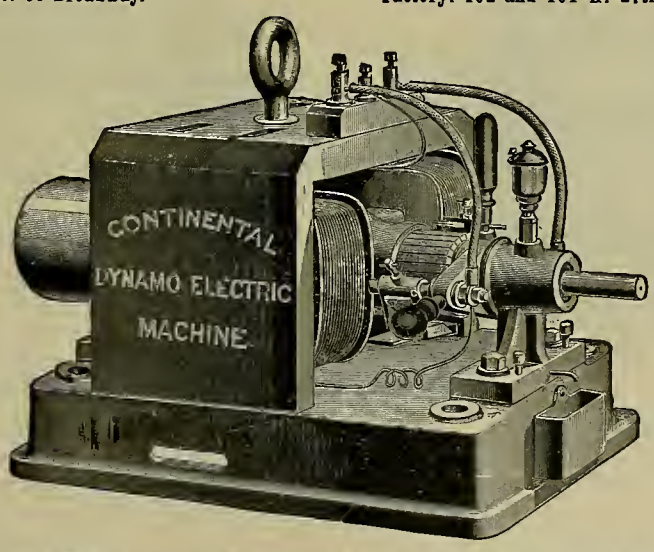

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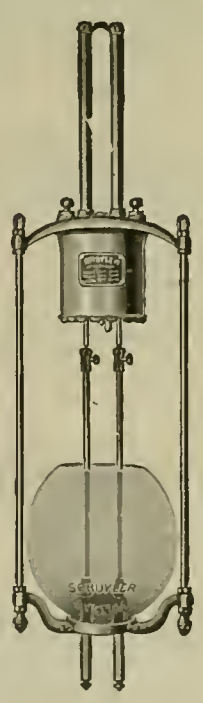

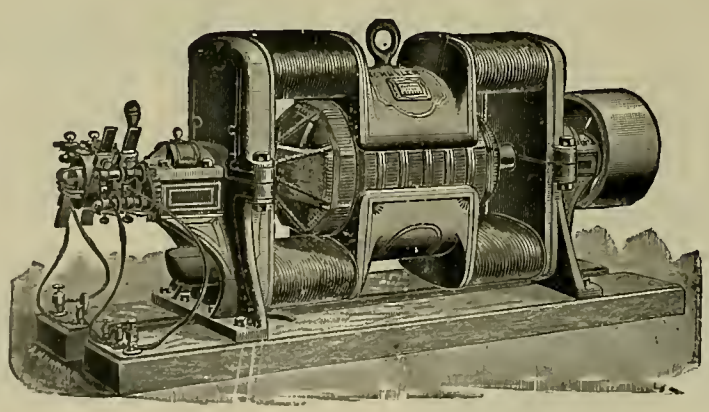

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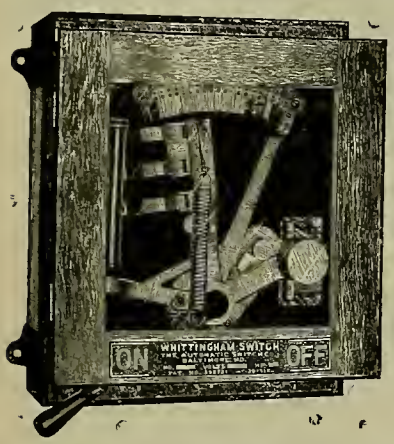

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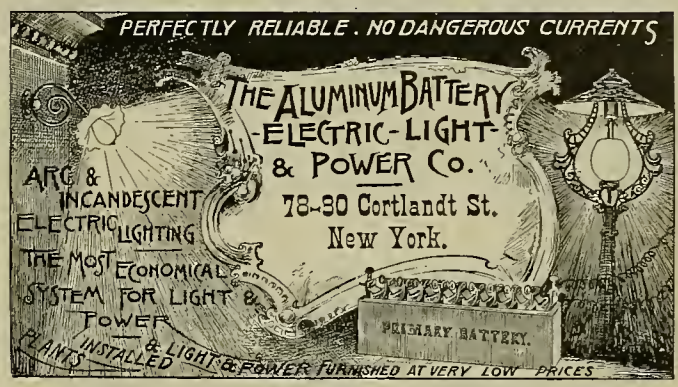

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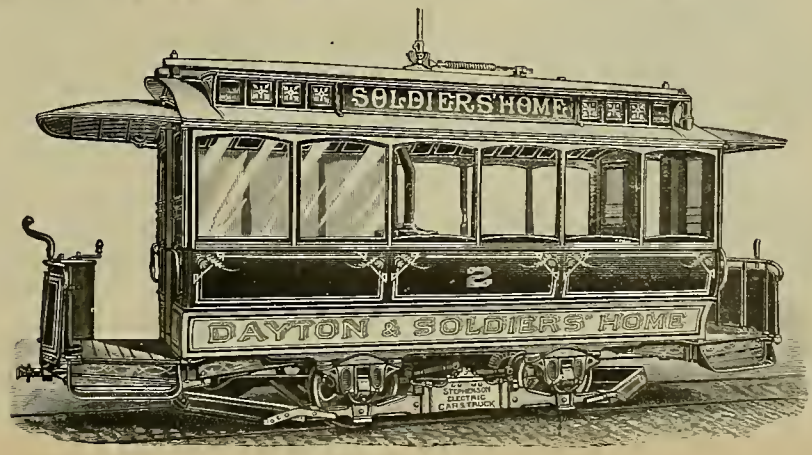

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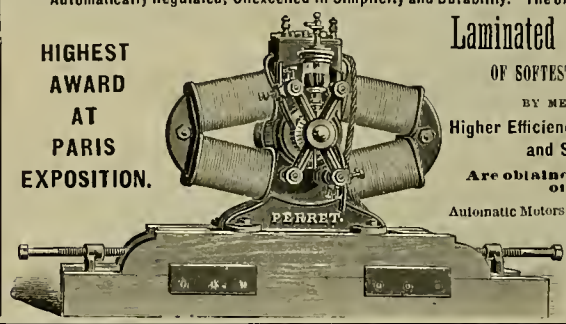

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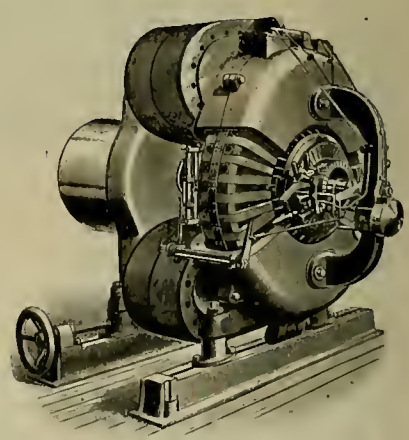

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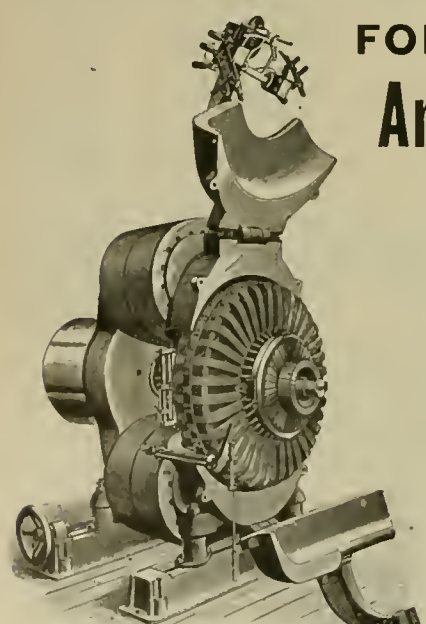

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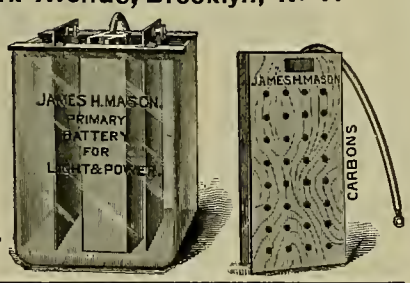

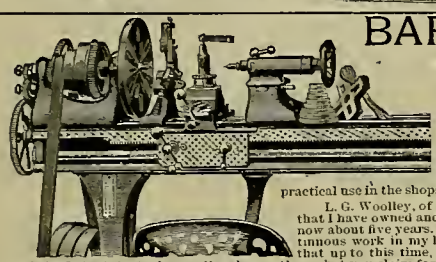

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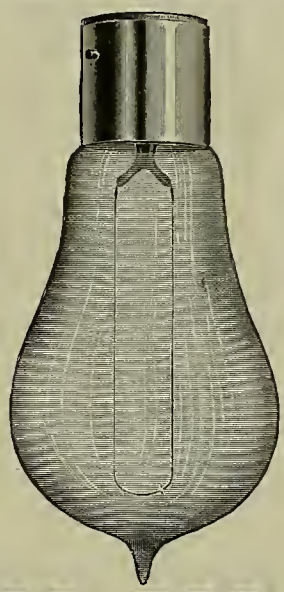

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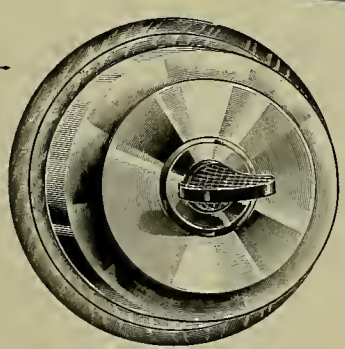

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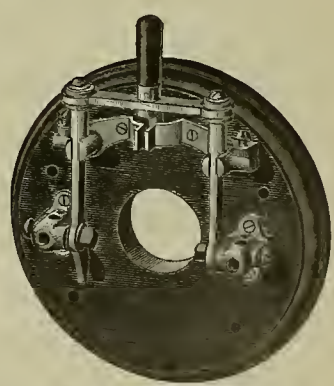

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The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:--

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208, and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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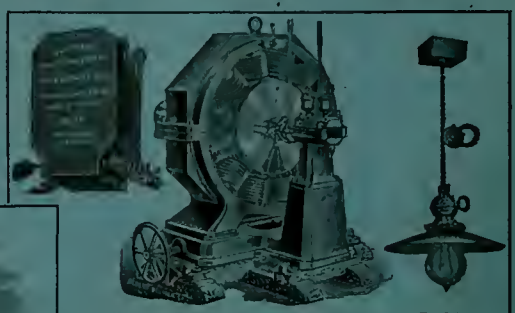

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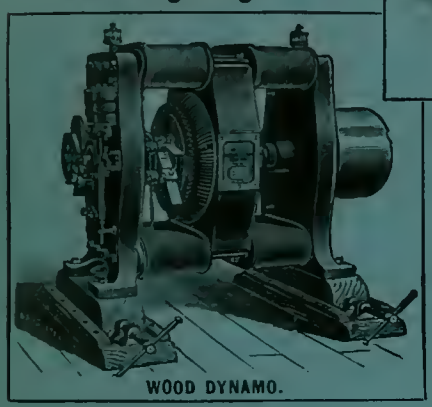

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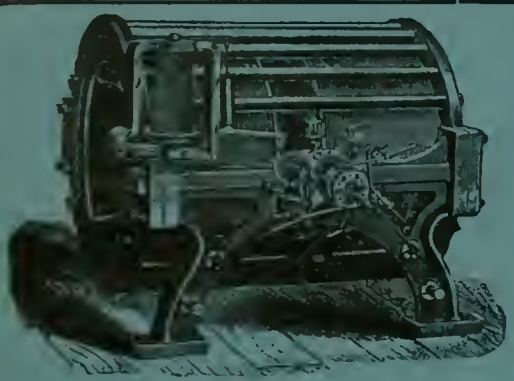

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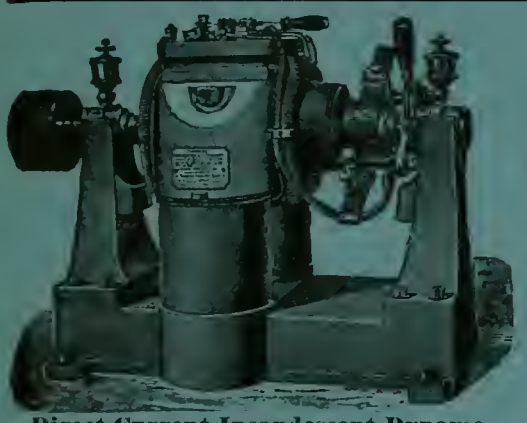

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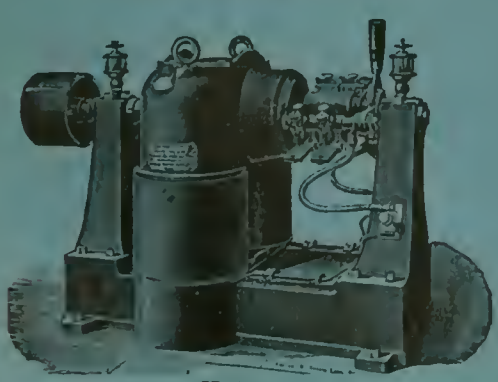

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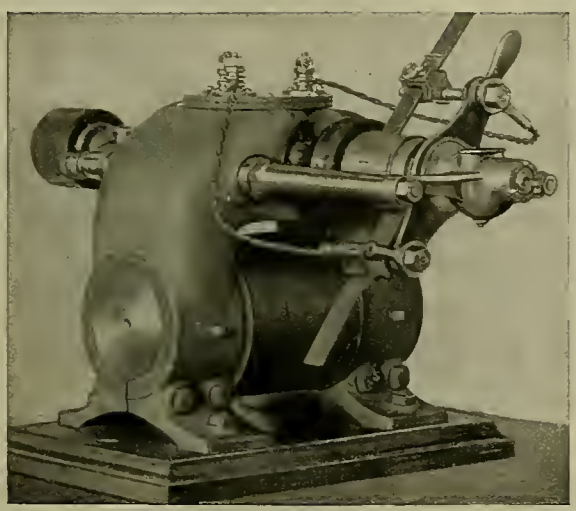

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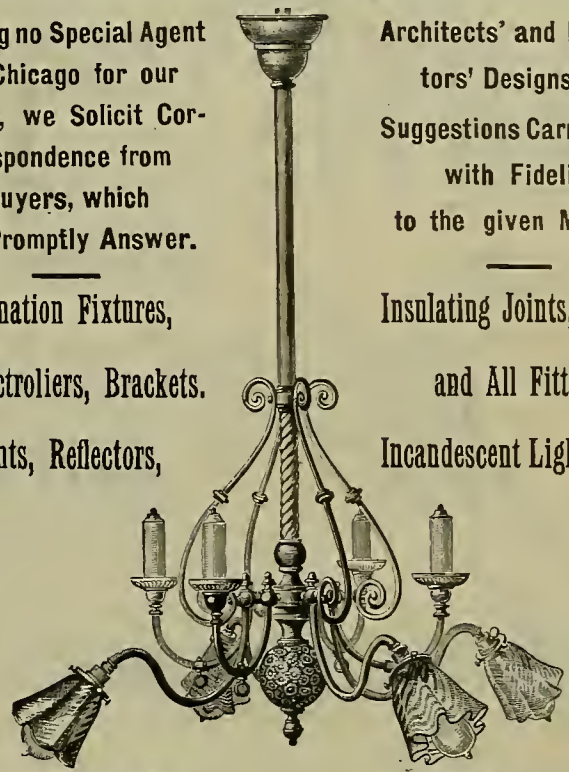

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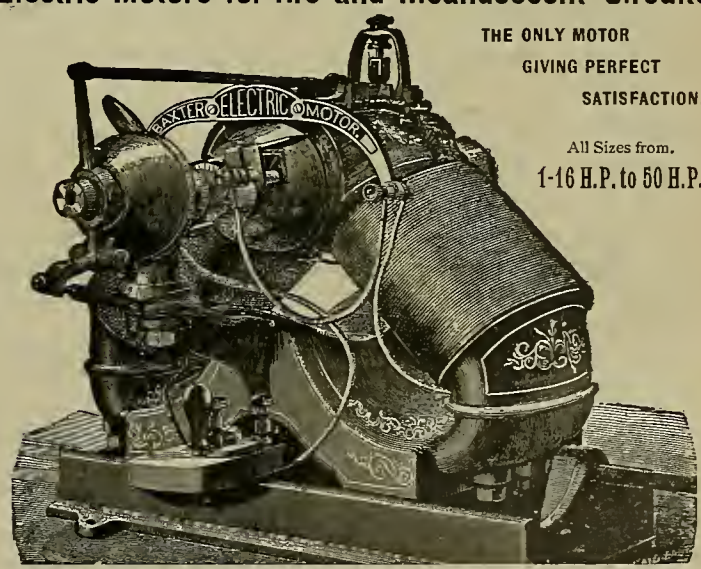

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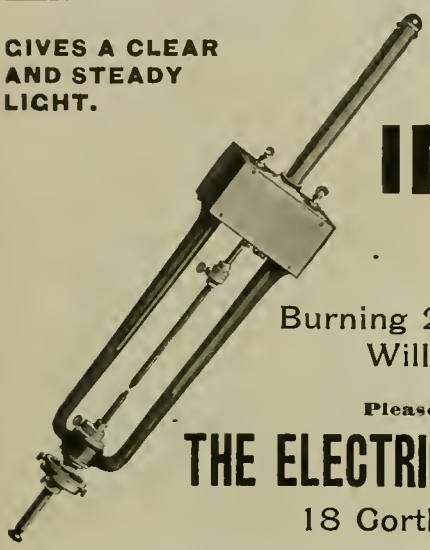

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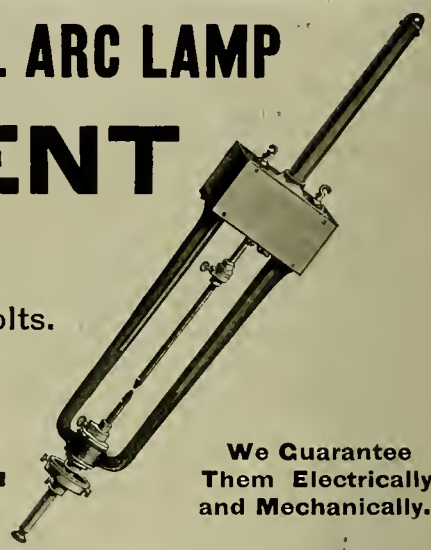

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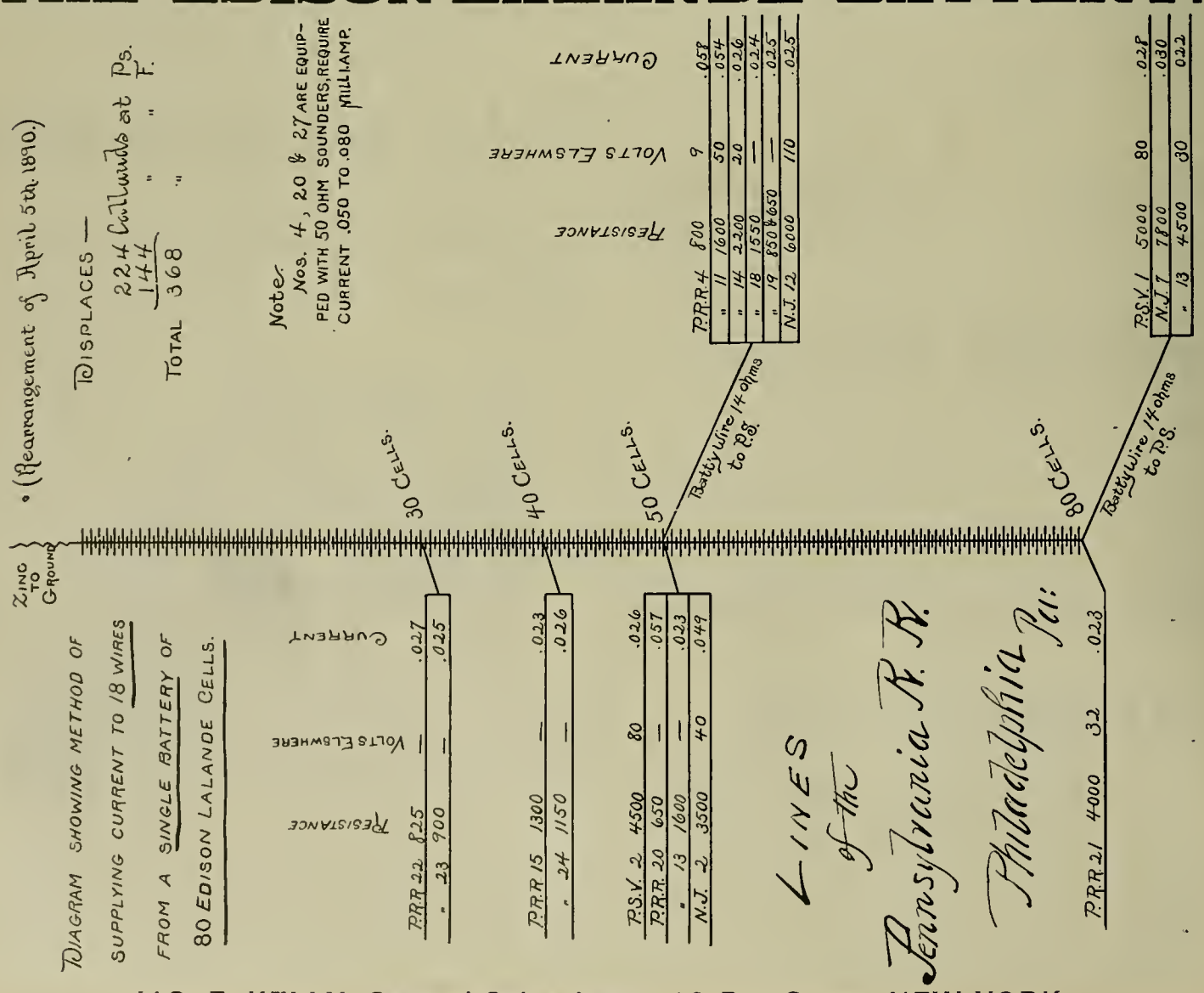

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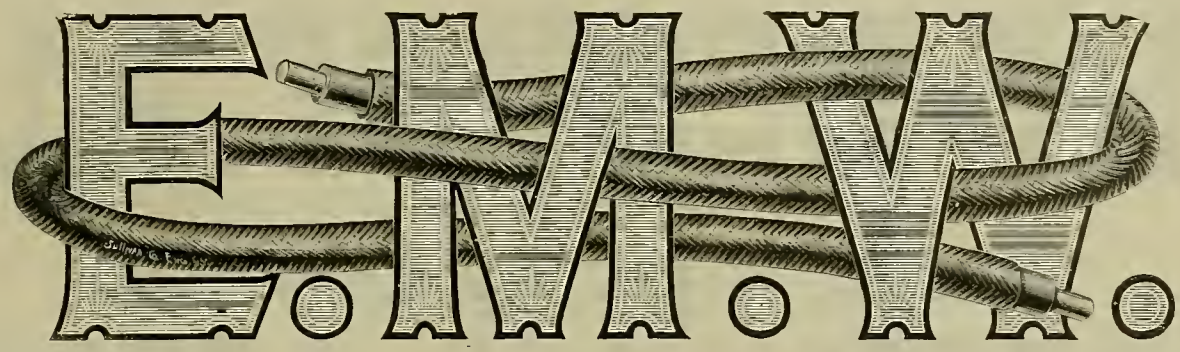

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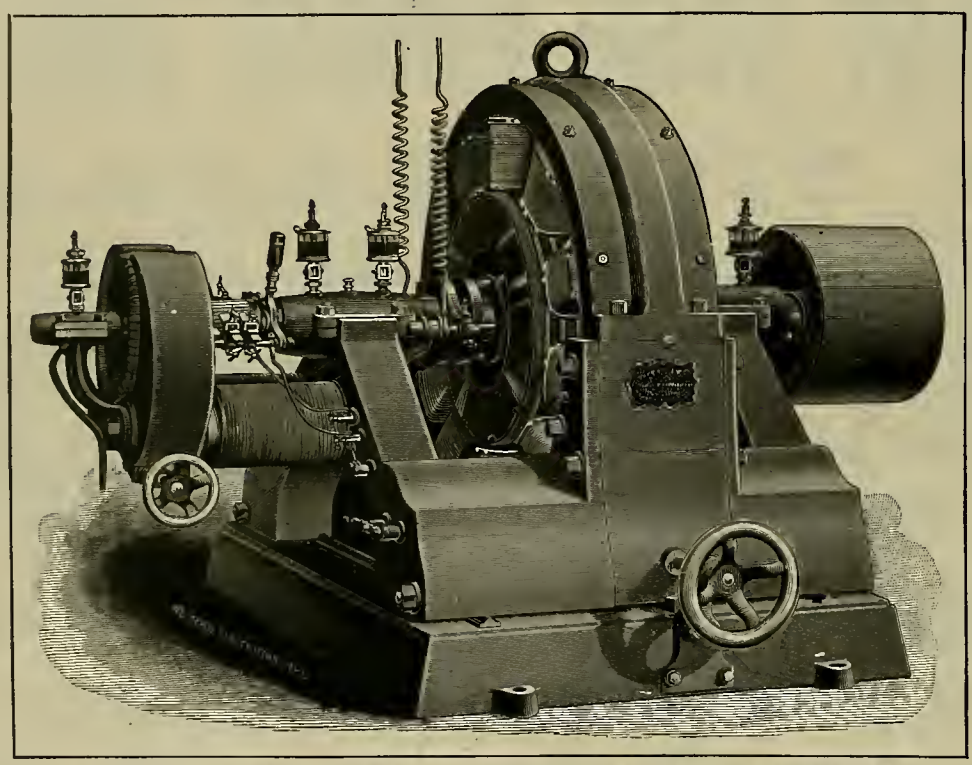

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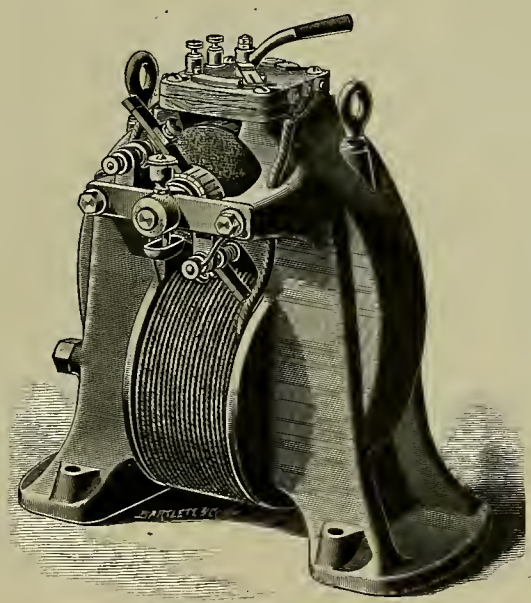

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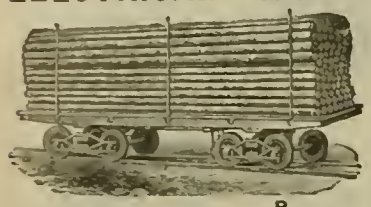

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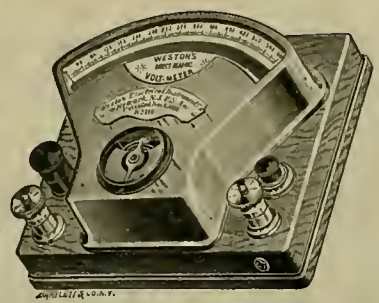

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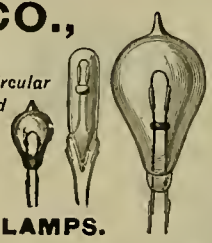

MINIATURE INCANDESCENT LAMPS.

NATIONAL ELECTRIC LIGHT ASSN. KANSAS CITY. C=E/R FEBRUARY. 1890.

SPECIAL NOTICE.

VOLS. VII and VIII,
PROCEEDINGS OF THE
Nat'l Electric Light Ass'n Conventions,
Held at Niagara Falls and Kansas City,
Will be published in July (in book form, cloth bound).
It has been decided to accept a few pages of appropriate advertising. This matter has been placed in charge of the
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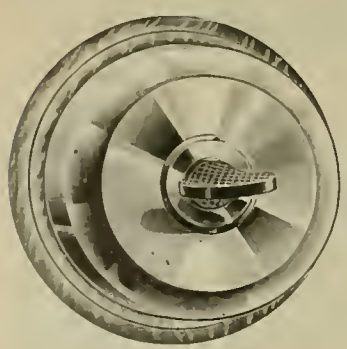

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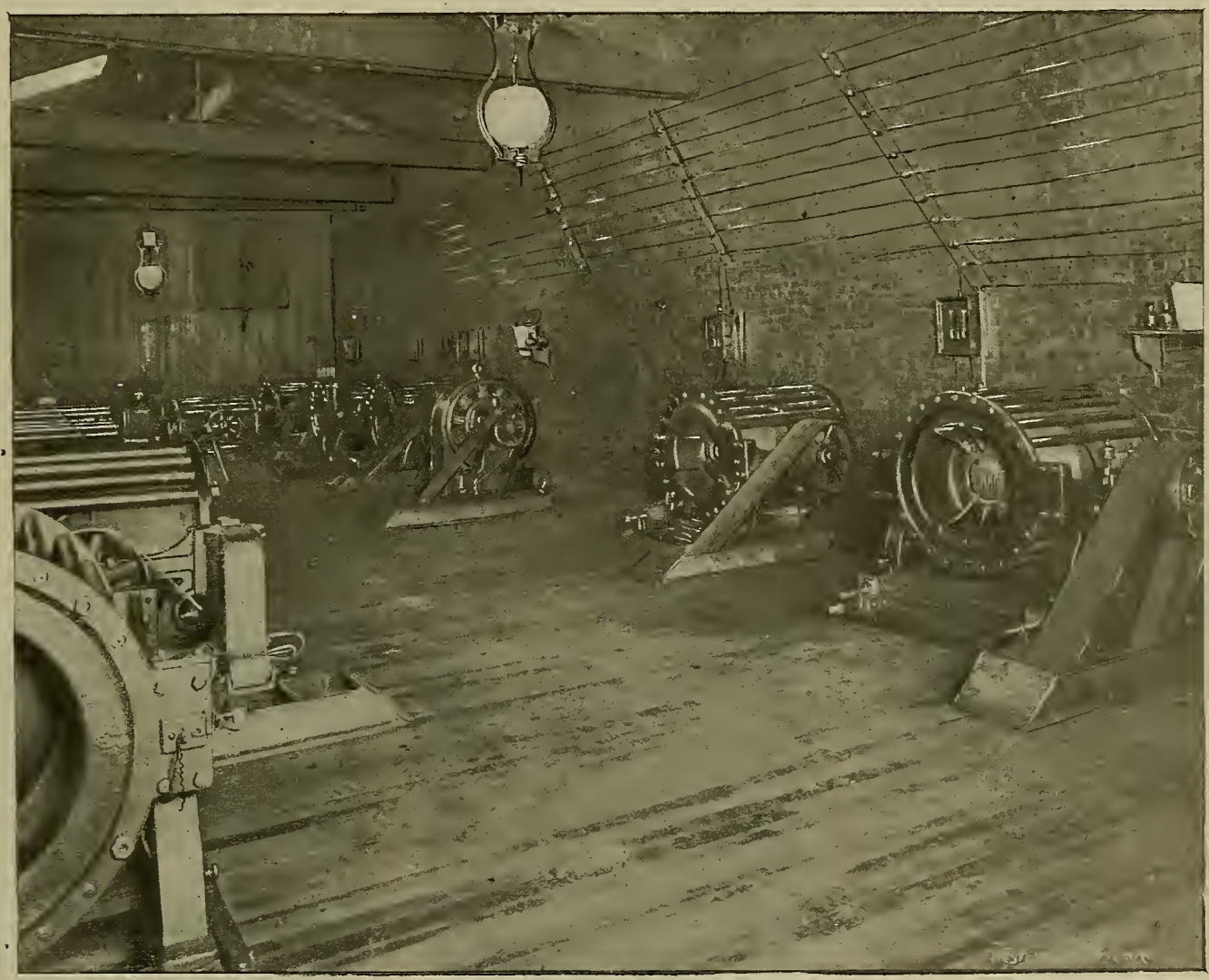
EVERY SATURDAY.

Vol. VI. CHICAGO, JUNE 21, 1890. No. 25

Dynamo Room in the Kansas City Electric Light Company's Station.

In the accompanying illustration is presented a view of the upper dynamo room in the arc light station of the Kansas City Electric Light company. This station is located in what is termed by Kansas citizens as "the hollow," and is close by the railroad. The building is of red brick, rather dingy and smoky in appearance, and may be distinguished from a distance by its tall brick smokestack. The plant is so arranged that the boilers and engines are on the ground floor where are also located a number of Thomson-Houston arc machines. The room illustrated is just above. The offices of the superintendent, lamp rooms, etc, are also on the second floor. The steam plant consists of 8 boilers and 5 engines. The battery of boilers consists of five of 125-horse power nominal capacity and four of 75-horse power. Eight of these are tubular and one is a Babcock & Wilcox. The engines in operation are one 150-horse power Corliss, five 60-horse power Ide, one 75-horse power Corliss, one 75-horse power Buckeye, and one 150-horse power Buckeye. With the exception of the larger engines all those above mentioned are belted direct to Thomson-Houston machines on the lower or ground floor and on the floor above. As will be noticed from a close inspection of the cut an alternator and two direct current incandescent machines are running on this floor. From this it may be judged that the company finds both the alternating and direct current to have its place and respective advantages. The plant taken as a whole supplies current for 893 arc lamps, 800 direct current 16-candle power incandescent, and 500 alternating incandescent lamps. Of the 893 arc lamps 70 are used for city lighting. All the machines are of Thomson-Houston manufacture.



DYNAMO ROOM IN THE KANSAS CITY ELECTRIC LIGHT COMPANY'S STATION.

Chicago Electrical Franchises.

Enterprising capitalists who secured franchises from Hyde Park, the Town of Lake and other suburban districts, just before annexation, will soon reap the reward of their shrewdness. Within the last few days applications for permits have been made to the commissioner of public works by three different companies, two of them holding electric light franchises granted by the old towns of Hyde Park and Lake, and one which possesses an electric railway franchise. The terms of each ordinance are so liberal and their passage so closely preceding annexation that each application has been referred to the law department.

This, however, is not the first case of the kind that has appeared, and these have been in like manner referred to the law department, but all to no purpose. It has been found necessary to honor the action of the old town boards. The objection to all these grants is that they give the holders of the franchises permission to construct overhead electric wires. It is claimed that many electrical franchises are held by speculators who are keeping them until a favorable opportunity presents itself to form a stock company and unload the grant for a consideration. A company organized to build an electric plant in Chicago would have less trouble raising money and disposing of stock at a good figure than one whose operations would be in Hyde Park or Cicero—hence the haste with which the ordinances were pushed through the town boards on the eve of annexation. It is not to be thought, however, that these franchises are not valuable property; such an impression would be erroneous. They are excellent investments, and all

the more valuable because they are Chicago enterprises rather than village ventures.

Shaping Filaments of Incandescent Lamps.

When the looped-shaped filaments of incandescent lamps are straightened by a weight during the period in which the air in the bulb is exhausted the removal of the weight is found to be a rather delicate operation. In straightening the filaments in this manner it has ordinarily been found necessary to attach to each lamp bulb an exhaust tube longer than usual. After the operation of exhausting has been completed this tube is first sealed some distance from the globe, and the lamp removed from the pump. By manipulating the lamp the weight is unhooked from the loop and dropped into the tube, which is then sealed off from the lamp. The accompanying diagram illustrates an improved method of handling the weight by

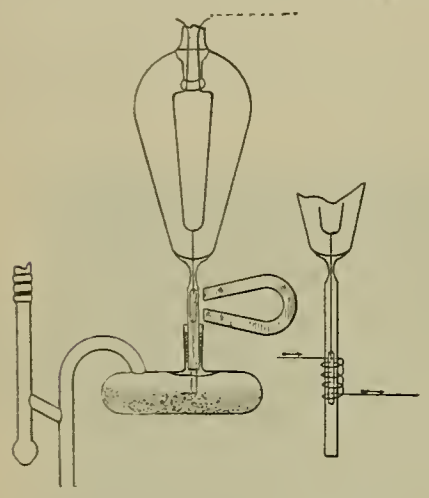


FIG. 1. FIG. 2.

SHAPING FILAMENTS OF INCANDESCENT LAMPS.

magnetism. A glance at Figs. 1 and 2 will show the simplicity of the operation. The small weight shown in the tube and hung on the filament is made of iron or other magnetic material. By this construction it is only necessary to use a magnet as shown in Fig. 1 or a solenoid as indicated in Fig. 2, and the weight may be manipulated as desired. It is evident, too, that the magnetism of the solenoid or permanent magnet may be employed to increase or diminish the strain or pull on the weight. This insures a delicacy of adjustment otherwise unattainable. This method of weight manipulation in the above mentioned process is the invention of R. N. Dyer of New York.

Litigation over Double Carbon Arc Lamp Patents.

The Brush Electric company is prosecuting its claims to the exclusive right to manufacture double carbon arc lamps, and last week secured three favorable decrees at Chicago. H. A. Seymour, of Washington, argued the cases before Judge Gresham. Two of the cases were against users of the Indianapolis Jenney lamps, the Nordyke & Marmon company and the Indianapolis Union Railway company. In these cases the defendants claimed that they were operating under an old contract between the Brush company and the parent Jenney company which entitled the Jenney company to manufacture double carbon arc lamps and therefore protected its patrons. The complainant denied this and in each case a preliminary injunction was granted, restraining the defendants from operating, selling or making lamps similar to those displayed and described in court. Judge Gresham's decree pronounces this lamp an infringement of the Brush patents.

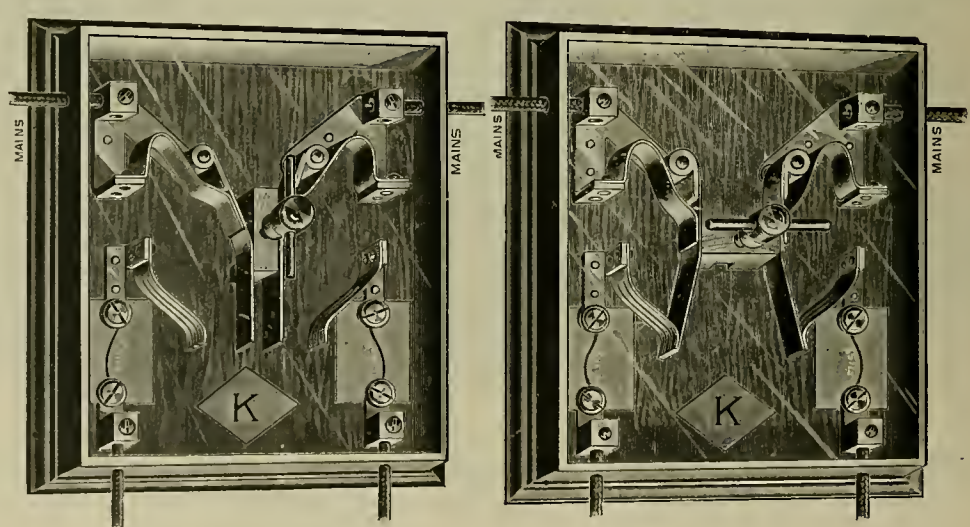
The last case was that against the Sperry Electric company of Chicago. F. W. Parker appeared for the defendant. In this action Judge Blodgett was called in by Judge Gresham and both gave the case the closest attention. The injunction was granted, Judge Blodgett concurring in Judge Gresham's opinion which follows:

The court finds as follows: That the double carbon lamps manufactured by the defendants, the Sperry Electric company, and produced before the court, viz.: One marked "Complainant's Exhibit New Sperry Double Carbon Lamp," wherein the two pairs of carbons are independently actuated and adjusted and burned successively, the feeding carbon of one pair having a supplemental clamp or device whereby it may be manually latched up and retained, separated from its mate during the burning of the other pair, the latched-up carbon being then automatically released, and the arc established and maintained between the second pair of carbons until consumed; the other lamp, the construction of which is shown in defendant's drawings, numbered 7 and 8, and wherein the two pairs of carbons are independently actuated and controlled and burned successively, and in which the feeding carbon of the idle pair is required to be manually latched up to insure such successive burning of the two pairs—each embodies the invention of Charles F. Brush, as described in said Letters Patent No. 219,208, and specified in the first six claims thereof, and that the complainant is entitled to an injunction, as prayed for, restraining the defendant company from manufacturing, selling or using either of such infringing lamps until the final hearing of this cause.

It is, therefore ordered, adjudged and decreed, that the defendant, the Sperry Electric company, its officers, agents, attorneys and employes be, and they are hereby enjoined until the final hearing of this cause, from directly or indirectly making, selling, offering for sale, or using any double carbon lamps, like or similar to those mentioned in the finding above set forth, or any arc electric lamps in which two or more pairs of carbons are independently adjusted and regulated, and are burned successively to secure the continuous burning of one pair of carbons prior to the establishment of the arc between the other pair, substantially as set forth and claimed in the first claim of Letters Patent No. 219,208, and also from making, using or selling any electric arc lamps containing the inventions set forth and claimed in the second, third, fourth, fifth and sixth claims, or any of said claims in said patent No. 219,208.

Diamond Combination Switch and Fuse Box.

The accompanying cuts illustrate the Diamond combination switch and fuse box, which has just been placed on the market by the Knapp Electrical Works, Chicago. This device, however, has stood the test of practical service in the plant at Armour's packing house, and it is now in use in several large installations in Chicago. It is intended for use in alternating current plants. The device should be placed between the main circuit and the converter, enabling the operator to cut out the converter without shutting down the entire system. For outside work the switch is placed in a watertight iron box and the key is so arranged that it can be removed if necessary. Another feature consists in the fact that the device can be operated right or left. The sliding contact points prevent any accumulation of dirt and insure good contact. Moreover, it is claimed that in breaking the connection no spark is caused. In the cuts the device is shown open and closed, and a glance will show the operation.



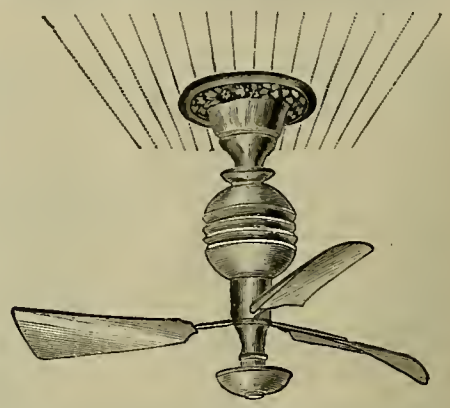
DIAMOND COMBINATION SWITCH AND FUSE BOX.

The fusing attachments are located below the lower contacts of the switch. When the switch is thrown off all danger of fusing is removed. This is an important feature, especially in bad weather, and where the converters are located outside or in bad places. The same style of switch is made in different sizes.

A. Shillinglaw, the electrician at the Union Stock Yards, Chicago, is the inventor of the device.

Ventilating Fan.

The ventilating fan illustrated in the accompanying cut is put on the market by the Central Electric company of Chicago. The fan is made by the Globe Fan company of New York. It is made entirely of metal nicely nickeled; it is light and ornamental in design, and especially adapted for use in residences, offices and stores. The fan is run in connection with a small motor and the Edison-Lalande battery. The motor



VENTILATING FAN.

can, of course, be run by the current from an electric light circuit where this is obtainable, but for sick-room and residence purposes the battery furnishes the necessary power.

Train Dispatchers' Convention.

The Train Dispatchers' association held a convention at St. Louis last week, 100 delegates attending. Many practical papers were read, and matters pertaining to the work of the members discussed. A large number of new members were admitted, and altogether the meeting was one of the most important ever held by railway telegraphers. Toledo, O., was selected as the place for the next convention, which will be held in June, 1891. The election of officers resulted as follows: J. H McEwen, Oswego, N. Y., president; R. B. Woolsey, Terre Haute, Ind., vice president; C. B. Case, Toledo, O., secretary; J. A. Weldon, Moberly, Mo., and J. F. Mackie, Bureau, Ill., members of the executive committee Committees were appointed on the following subjects: To prepare papers for discussion at the next meeting; train rules for moving of trains by telegraphic orders; to continue examination into the working in practical use of the general time convention code of rules by telegraphic orders; to investigate causes of accidents.

Electric Road in Chicago.

The Cicero & Proviso Street Railway company has made a formal application to the commissioner of public works of Chicago for a permit to construct an electric street railway, with overhead trolley wires, in the western part of the city. This company secured a franchise from the town board of Cicero just before that district was annexed to Chicago. Up to the present time the people living in that vicinity have had no street car service whatever. Now, however, the new company is ready for business. As recently announced in the WESTERN ELECTRICIAN the Sprague company has been awarded the contract. The material is already on the ground, the power house is under way, and the

cars are nearly completed. The petition for a permit has been referred to the law department, but as it has heretofore been decided in similar cases that the city must honor the acts of the old boards, it is probable there will be no delay about granting the application.

Japy Arc Lamps.

The accompanying cuts illustrate two forms of arc lamp, designed by Henry Japy of Paris. The object of the inventor, according to Paul Gahery, who writes the description in *La Nature*, was to construct a lamp in which the regulating apparatus would occupy only a small space. Fig. 1 represents an arc lamp, in which, it is stated, the feeding of the carbons is controlled by a shunt regulator. The complete lamp is shown at the left in the cut, and the regulating apparatus is represented on a larger scale at the right. It will be noticed that a link belt, which passes over a sprocket wheel, is substituted for a rack. This wheel engages, as shown, with the wheels of clock-work. At the left of this mechanism is a coil whose core works upon a lever arm. The lever has at one end a toothed metal piece which is held by a spring, shown at the right of the cut, against a tip on the top of an escapement. It is apparent that as soon as the current in the shunt coil increases as the result of separating the carbons, its core is drawn into the solenoid, and overcomes the pull of the spring; the arm of the lever is raised; the escapement is freed; the clock movement is set in motion, being actuated by the weight of the solenoid which carries the carbons, and the feeding of the carbons is effected. The last-named solenoid is held by two insulated sliders between the two rods of the lamp.

Fig. 2 shows the regulating mechanism of the differential lamp. Its operation will be readily understood by referring to Fig. 3. The current enters at *a*, passes through the main coil, and thence to the upper cross piece of the lamp, where it divides. A small portion passes into the shunt coil *S*, and the main current flows by the rod *m* to the brush *H*, to the electro-magnet *S''*, which attracts the plate *p*. This holds the upper carbon *C*. The current thence passes through the carbons and out at *a'*.

The shunt coil and main coil have cores *A* and *A'*, which are attached to the brass lever *B*, pivoted at *O*. Attached to the lever on the

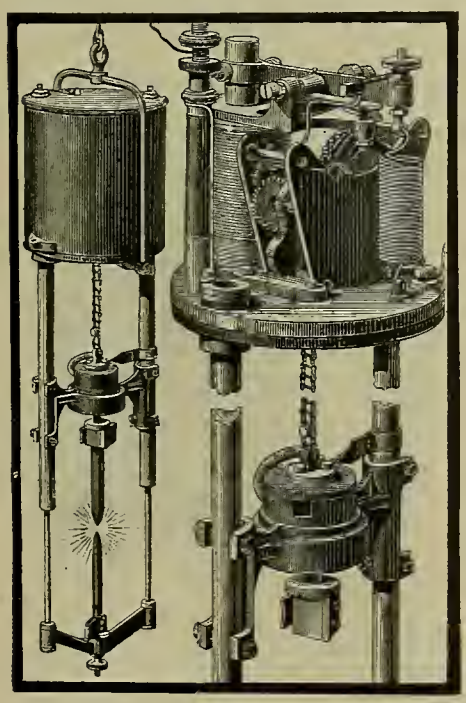


FIG 1. JAPY ARC LAMPS.

right is a toothed metal piece *E*, which holds tightly the tip of the escapement. When the current enters the main coil its core *A'* is drawn in and holds the escapement of the clock work; the electro-magnet at *S''* is operated and lifts the upper carbon, and the lamp is lighted.

As the resistance to the passage of the current increases by reason of the consumption of the carbons, more current passes into the shunt coil *S*. Its core is attracted and draws down the lever *B*, which unlocks the escapement and sets free the clock work. It is easy to see what then happens. One extremity of the chain on the lamp carries the upper carbon. The other passing over the toothed wheel is attached to the lower carbon carrier, which slides in the rods *m*, *m'*. The carbons are thus fed toward each other at an equal rate. In order to increase the sensitiveness of the regulating apparatus, one of the

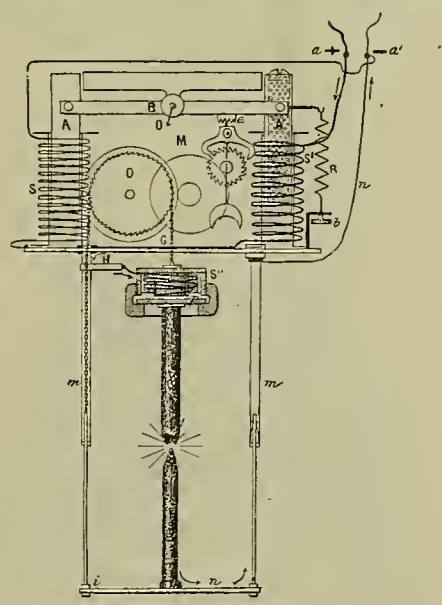


FIG 3. JAPY ARC LAMPS.

cores *A'* is made hollow, so that its weight may be adjusted delicately by introducing lead filings. The spring *R* serves for further adjustment. In testing the lamp, Mr. Gahery states that he has found that the brush *H*, leading from the rod to the carbon carrier *S''* does not operate entirely satisfactorily. As shown in the cuts, the positive carbon which is consumed more rapidly than the negative carbon, is twice as large as cross section.

Accumulators for Telegraph Work.

At a recent meeting of the Electrical Society of Berlin M. Strecker, chief engineer of the goverment telegraphs, read a paper on the use of accumulators in telegraph work. He favored the employment of secondary batteries, because he said they furnished the most reliable and most simple means of obtaining current for a telegraph system. The German telegraph department had become interested in the subject, and after instituting tests for several years, determined to employ secondary cells regularly. Twenty five cells of the Tudor accumulator were installed in one of the telegraph offices in Berlin. The batteries had a capacity of 25 ampere-hours. They are charged by a Siemens & Halske shunt dynamo which is driven by a four horse-power Otto gas engine. The current is led from the telegraph office to the central office, a distance of about a mile, by means of a cable and is used in operating sixty-eight lines. One charge of the batteries is sufficient to last from thirty to forty days. The batteries are charged without interfering with their use in telegraph work. The cells were introduced in October last. Their operation has been so satisfactory that it has been decided to employ them on an extensive scale in the telegraph department.

Electric Elevated Roads.

W. N. Smith of Sibley College of Cornell University, Ithaca, N. Y., prepared an interesting thesis on electric power on elevated roads, and its application to the projected Chicago lines. The aim of the writer is to show the feasibility of substituting electricity for steam on the elevated roads, as a step toward its general application to longer lines of railway. After reviewing the work in this line by the most promising experimenters and investigators, he discusses in detail the principal considerations affecting the problem, and presents original designs for motors and trucks to be used. The writer thinks the motor car preferable to the separate locomotive, and would adopt a 3-wire overhead system, the track being the neutral conductor, and the copper lines being over each track. Each motor car is of about 176 horse power, and will haul two loaded coaches of the usual type. In the proposed system the power station is equipped with triple expansion engines of 500 horse power and two multipolar Crammering dynamos to each engine. Practical conditions are taken in Chicago for the three lines, and the cost of equipment, both steam and electrical, are estimated on a mathematical basis. It was found, Mr. Smith says, that the electrical equipment of ten miles of elevated railway trains to run at a maximum rate of 30 miles per hour, and 3 stops per mile, would cost about $1,078,000 more than the steam equipment; but the saving in fuel by an electrical system would be about $800 per day, with total efficiency, from engine to car axle, of only 55 per cent. Such a system would pay for its extra cost, simply in fuel saving, in less than 4 years; while its other advantages are so obvious, that as soon as railroad managers can be convinced of its practicability, electricity will supersede steam.

Municipal Ownership of Plants.

The question of municipal ownership of public lighting plants is attracting as much attention abroad as in this country. According to English exchanges, many cities are contemplating the introduction by the municipality of electric light plants for street illumination. The London *Electrical Review* says: "As many towns will shortly be adopting electric lighting on their own account, it would be well if attention were drawn to the figures which occasionally reach us from America. In answer to inquiries made in a well known town in the States which has been lighted by the municipal body for a few years past, it appears that electric lighting has not been so great a success as the opponents of private enterprises claim. The town authorities distinctly state that with their experience they are not in favor of cities doing their own lighting in consequence of political preferences and frequent changes in the management which means great expense. It further states that incompetent engineers, linemen, and trimmers are kept in place for political or other purposes, and what with poor carbons, lack of attention generally, grounding of wires, breaking of globes, infringements of patents, constant repairs, etc., the system is not only expensive, but of an unknown amount, till the working year expires. On the contract plan one pays for what he gets only, and we know what to provide for in the estimate for the tax levy. In conclusion, they would not undertake the lighting of the city if it were to be done over again. This is the somewhat bitter experience of a town which has supplied its own light for a considerable period, and coming from the country of electric lighting *par excellence*, we should imagine it ought to carry some weight with those venturesome vestries who anticipate that their electric lighting schemes are easy of execution."

It is to be regretted that our contemporary did not specify the town from which these interesting figures and statements were received. Chicago has been looked upon as the pioneer in the field, as it is really the only city in this country, at least, that has attempted to provide a permanent electric lighting system, and it is safe to say that no one connected with the administration who could furnish authentic figures made any such statements as those alluded to. It is to be regretted that the system of municipal government in this country furnishes only too good grounds for the apprehensions expressed. In the matter of appointments political preference must always exercise a detrimental influence over the efficiency of any department where mechanical or technical skill is required. At present the electrical department of the city of Chicago is of minor political importance so far as the number of employes is concerned, and City Electrician Barrett has succeeded thus far in keeping it out of politics. As the department develops and the number of employes increase he will find it much more difficult to maintain the efficiency of the system as the demands of politicians for patronage will become more pressing. The future prosperity of the department depends largely upon

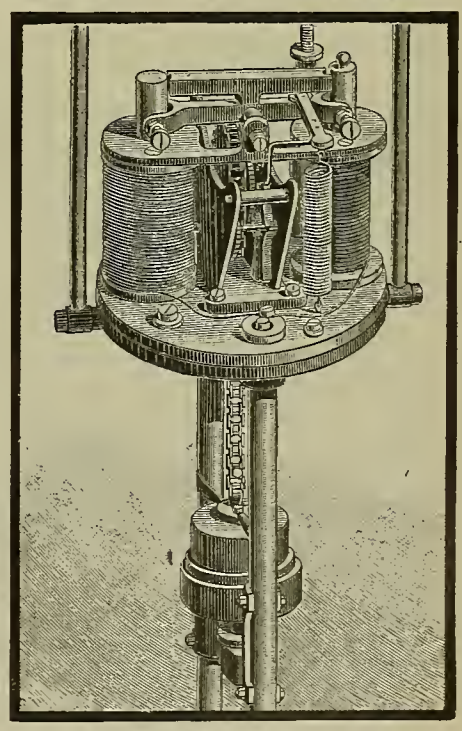


FIG. 2. JAPY ARC LAMPS.

its entire separation from politics. The same rule will hold good in other large cities.

City Electrician Barrett, of Chicago, recently recommended that the electric lighthouse at the 'crib" be furnished with a blue light instead of a white light, in order to avoid confusion among vessels entering the harbor. The recommendation has been under the consideration of the Light House Inspecting board of Washington, and has been approved.

Wire Calculator.

One of the most important problems to be solved by the practical wire man is that of proportioning the size of the wire necessary to carry safely and economically the amount of current requisite for a given number of incandescent lamps. A number of charts and tables have been prepared with a view of helping wire-men in this difficulty, but these at the best have a number of disadvantages. With the object of meeting the demand for something which would present the advantage of enabling the wire-man to obtain results with greater rapidity and much more conveniently, E. S. Greeley & Co. of New York have just put on the market the little device illustrated in the cuts. The instrument is called by the inventors an automatic wire calculator. It consists of two disks of stiff cardboard of unequal size, the smaller one being mounted in the center of the larger, and made to revolve thereon. On the back of the larger cardboard are full directions for the use of this unique and useful tool. The one shown is arranged for the calculation of wire for a current of 110 volts, and it is understood another is in preparation arranged for 55 volts.

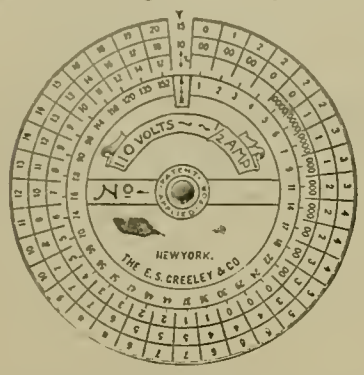


FIG. 1.

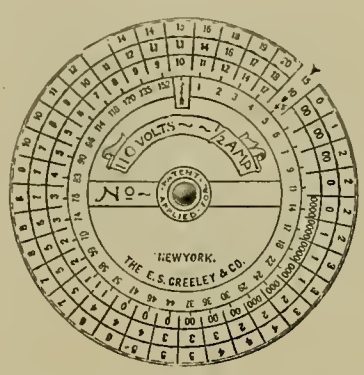


FIG. 2.

WIRE CALCULATOR.

The process of calculation is shown in the illustration. Fig. 1 represents the two disks in their normal position and Fig. 2 shows the position of the disks after the calculation to determine the size of wire suitable to carry a current 5,000 lamp-feet has been made. The lamp-feet are obtained by multiplying the distance in feet by the number of lamps; that is, 50 lamps at 100 feet, or 10 lamps at 500 feet, or 500 lamps at 10 feet. It is then only necessary to turn the inside dial until the figure 5 on the scale of the inside disk comes opposite the arrow which is upon the outside disk. This operation is shown completed in Fig. 2. When this has been done the arrow upon the inside disk will point to the size of wire which it is desirable to use, and which in the present instance is shown to be No. 10 for a 5 per cent. drop, No. 13 for a 10 per cent. drop, and No. 14 for a 15 per cent. drop.

The Utica Belt Line Railway.

The Utica Belt Line railway, which is herewith illustrated, has recently been put in operation under the Thomson-Houston electric railway system. The total length of the track is 20.37 miles; 15.84 miles single, and 2.27 miles double track. Seven and eight-tenths miles of single track are located near the curb line, on which the single bracket suspension is used; on the remaining track cross suspension is employed with one or two exceptions. There are 32 turn-outs aggregating 6,200 feet in length, 18 single and one double track curves, and eight steam railroad crossings. The maximum gradient is 8 per cent. and occurs at a distance of about 1,500 feet from the power station, and extends a distance of about 300 feet. There is one curve with a 50 foot radius, which has a grade of 5 per cent. The station is a handsome one story brick building, equipped with necessary minor apparatus for a first class power plant. It is well built, finely lighted, and the arrangement of the apparatus is admirable. At present three 200-horse power Armington & Sims compound condensing engines are in place, and a battery of 4 boilers for supplying the necessary steam is employed. The station is admirably situated as far as coal and water supply is concerned, the water being obtained from a large canal on one side, while the coal is dumped directly from the steam railroad cars on the other side into the boiler room. Six 80-horse power Thomson-Houston railway generators are now in daily use. The station switch-board which contains the auxiliary electrical appliances is very handsome and finely constructed throughout. The car equipment consists of 25 cars each equipped with two 15-horse power Thomson-Houston railway motors.

THE UTICA BELT LINE RAILWAY.

The Chelsea Electricity Supply Company's Station and Sub-Stations.

The system of distribution adopted by the Chelsea Electricity Supply company of England in which storage batteries are provided of sufficient capacity to supply the whole demand for current, says the London *Electrician*, is worthy of careful study and attention; because, although somewhat complicated at first sight, it is free from the objections which have been so strongly urged against other systems.

The system consists essentially in the establishment of a number of sub-stations, which are distributed over the area of supply, each furnished with a large storage battery, which is divided into two parts, so that one may be charged while the other part is feeding the distributing network. At the time of greatest demand both halves of the battery are coupled up in parallel with each other to the distributing network. When being charged the half-battery at each sub-station has its cells coupled in series throughout, and the several sub-stations are also connected in series by the charging cable so that a high tension current is employed to effect the charging. The discharging halves of the batteries have their cells coupled in sets of 55 for 100-volt circuit, which are then coupled in parallel to the distributing network. Continuous current transformers are to be put down at each sub-station. In some tests which have already been made with this machine the efficiency was 75 to 80 per cent. The transformers absorb the full power of the engines and dynamos, and are intended to be coupled to the distributing feeders, parallel with the batteries, at the time of maximum demand during the winter months, they will be regulated so as to work at full load—that is, their e. m. f. will be slightly higher than that given by the batteries, the object of which is to avoid running the engines with light loads, and to maintain the batteries as fully charged as possible. It was stated at the meeting of the Chelsea company in February last that the coal consumption per board of trade unit delivered to the customers was, on the average, about 11 pounds, which is a much lower figure than that recorded with any other system of supply, and which may be accounted for by the fact that the plant is never running except on full load.

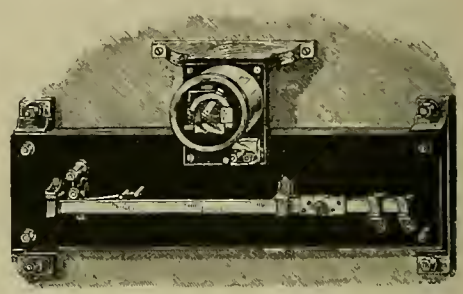


FIG. 1. CHELSEA COMPANY'S SYSTEM.

One of the features of the system is that the number of charging dynamos in operation always equals the number of half batteries being charged. The dynamos and half batteries are connected all in series, and when a battery becomes fully charged and is cut out of the charging circuit the corresponding dynamo is stopped at the generating station. This will be effected automatically eventually; but at present it is done by the attendant, who sees by his voltmeter and ammeter the moment when a battery is cut out of circuit.

The number of charging dynamos already fixed is five, four in operation, that being the number of sub-stations, and one spare. The dynamos are mounted on the same bed plate and coupled direct to Willans compound engines, flexible couplings are employed, and the dynamo spindle is insulated from the engine by the interposition of an ebonite disk and collars. The dynamos are of the Victoria type, giving an e. m. f. at their terminals of about 530 volts and 75 amperes, at a speed of 424 revolutions per minute. The field magnets of the charging dynamos are excited from a separate dynamo driven by a small engine. The exciting dynamo is compound-wound for constant difference of potential, so that no variation is caused by switching off the magnets of one or more of the charging dynamos. The armatures of the charging dynamos are coupled in series as before explained. A variable resistance is provided in connection with the field coils of each, so that the e. m. f. can be adjusted independently on all the

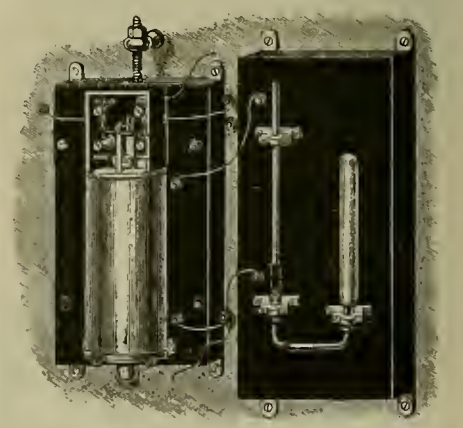


FIG. 3. CHELSEA COMPANY'S SYSTEM.

dynamos. When both halves of a battery become fully charged, and are consequently cut out of the circuit, the exciting circuit of a dynamo is broken, and the armature afterwards short-circuited. For a moment, then, the charging current flows through the inactive armature; but it will be seen that this has no objectionable result. The switches which control the exciting and armature circuits

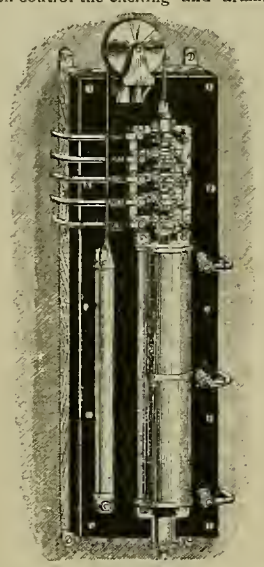


FIG. 4. CHELSEA COMPANY'S SYSTEM—STEP BY STEP DEVICE.

of each dynamo are ranged side by side; and a star wheel placed between them prevents the possibility of the armature being short-circuited before the exciting current has been broken, or the exciting current being put on before the armature has been thrown into the charging circuit.

In order to avoid a back current flowing from the batteries through the armatures of the charging machines consequent on any mistake on the part of the attendant, or a mishap, such as the sudden stoppage of the exciting current, a gravity switch, which breaks circuit if the current falls below a minimum value, is inserted in each of the charging leads; and to avoid disastrous consequences, should these fail to act in event of a sudden reversal of the current, a safety device is introduced, Fig. 1. It consists of a magnetic cut-out, set to act at 80 amperes, which is connected in the charging circuit; a fuse wire, which supports the heavy copper switch bar, is connected in parallel circuit with the magnetic cut-out.

The four sub-stations now in operation are situated at Draycott place, Clabon Mews, Egerton Mews, and Pavilion road. The last named is just being started. Each sub-station contains 454 E. P. S. cells of the size known as 31 L, *i. e.*, 440 for supplying the lamps and 14 back e. m. f. cells. Each cell stands on a separate wood tray, which again rests on oil insulators. A light traveler is fitted up in each battery room, with the help of which any of the cells can be removed for inspection or repair.

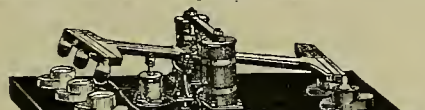


FIG. 6. CHELSEA COMPANY'S SYSTEM—MERCURY SWITCH.

Upon commencing the day's charging the attendant at the generating station turns on a small switch for each sub-station, after which he switches the charging dynamos into circuit. Each small switch controls a relay at the sub-station connected with the operating magnet of a large transposing switch, Fig. 2, which is provided for each half battery. The function of the transposing switch is to connect the cells of the half battery either in series and to the charging main, or in parallel and to the distributing feeders, which it does by means of a number of contacts which are mounted on a rocking framework. When the rocking frame is down on one side, the set of contacts on that side dip into the set of mercury cups and connect the battery in series for charging; and when it is down on the other side the other set of contacts dip into the other set of mercury cups and connect the battery in parallel for discharging. Suppose, then, that the attendant at the generating station has turned on the switch which sets the automatic apparatus in operation, the transposing switch of the first half battery is thereby thrown over from discharging to charging side, and the charging proceeds. In order to automatically cut the battery out of the charging circuit as soon as it is fully charged, a single negative plate in the half battery is selected, and a cap is arranged to catch the gas given off by the plate. The gas is led through a bubbling bottle into a small gasometer, which is adjusted so as to make a contact when the cells are properly charged, which operates a magnet on the transposing switch, causing it to rock over, and connect the cells in parallel onto the distributing feeders. The movement of this transposing switch makes a contact which causes the transposing switch of the second half battery to rock over from the discharging to the charging position, and the charging goes on until the gasometer, which in the meantime has been emptied by an electrically operated valve, has again risen high enough to make contact, when the second half battery is disconnected from the charging mains and thrown onto the distributing feeders parallel with the first half. To prevent the charging circuit being broken a carbon resistance is automatically connected across the terminals of the charging mains before the charged half of the battery is disconnected, and remains connected until the second half of the battery is connected in for charging.

The regulation of the e. m. f. delivered to the distributing feeders is performed as follows by means of counter e. m. f. cells. By this arrangement the whole of the cells are uniformly discharged, a condition essential to the maintenance of the battery in good order. These regulating cells are automatically switched in and out of circuit. For this purpose a pair of pilot wires are brought from the point on the network where it is desired to maintain a constant e. m. f. These pilot wires are connected at the sub-station to the terminals of a governor, Fig. 3, which consists of a high resistance solenoid—ingeniously compensated for temperature variations—with a balanced core, to the top of which is attached a cross arm, carrying four contacts. When the e. m. f. is normal the cross arm remains in a central position between four other contacts. If the cross arm is pushed upwards consequent on an increase in the e. m. f., the top contacts on the cross arm close a relay circuit, which operates a step-by-step device, Fig. 4, which at each step causes a back e. m. f. cell to be introduced into the circuit, through the intervention of the mercury switch, Fig. 6.

When a sufficient number of cells has been introduced

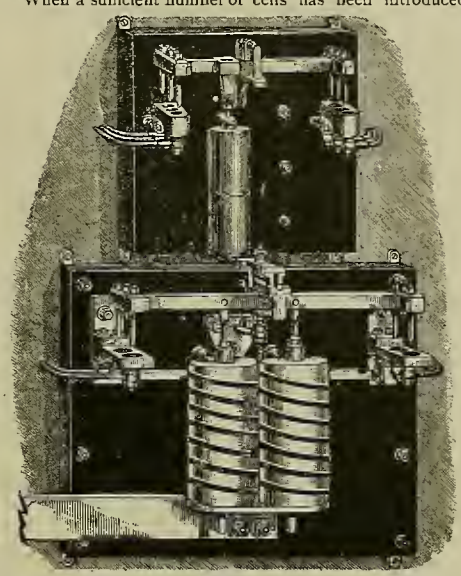
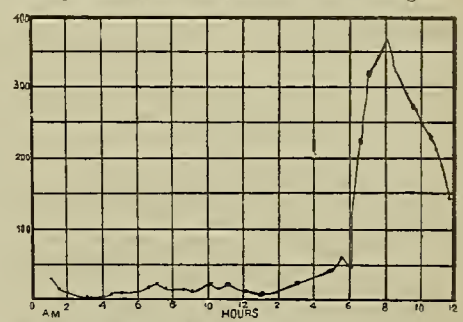


FIG. 5. CHELSEA COMPANY'S SYSTEM—CURRENT REGULATOR AND RELAY.

the core moves down breaking the contact, and the action ceases. Similarly, if the e. m. f on the network falls, the core of the governor descends, the cross arm makes another pair of contacts, and the reverse action cutting out back e. m. f. cells takes place. The solenoid of the governor, through which the current from the pilot wire passes, is compensated against the effect of the surrounding temperature, which would otherwise cause considerable variation in the voltage maintained on the network. Instead of both ends of the operating solenoid being connected directly to the pilot wires, one end is connected through a carbon rod about 1-32 inch diameter, which introduces resistance. This carbon rod passes down the center of a small glass tube which is partly filled with mercury. The mercury is in connection with a closed chamber filled with alcohol, the expansion and contraction of which when the temperature of the room varies causes the mercury to rise or fall in the tube and to short-circuit more or less of the carbon rod. This device is adjusted to keep the total resistance always the same, and thus compensate for variations of temperature.

If the difference between the currents delivered by the two halves of the battery exceed 10 per cent. on the whole, back e. m. f cells are introduced into one half, or cut out of the other through the intervention of the current regulator, Fig. 5, which consists of two solenoids formed by cutting a spiral out of a piece of copper tube. The spirals are placed side by side, and the current from each half of the battery passes through them. The solenoids pull down either one side or the other of a balanced contact rim, which causes, through the medium of the relay, Fig. 5, and the step-by-step device, Fig. 4, a back e. m. f. cell to be switched out of the half-battery which is not supplying its share of current.

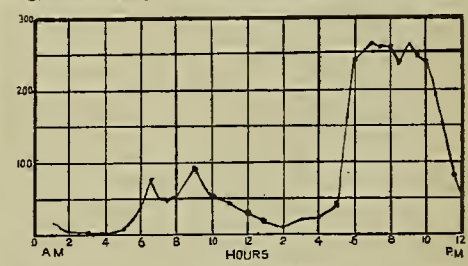
A large main switch and ammeter for the discharge circuit and an ammeter for the charging circuit is provided, and also a smaller ammeter having flexible leads and a wedge contact, which when forced between the proper contact plates diverts the current from any group of 55 cells through the ammeter.



CHELSEA COMPANY'S SYSTEM—CURRENT CURVE, DRAYCOTT PLACE STATION.

The present capacity of the station and sub-stations is about 10,000; but the ultimate capacity, reckoning the continuous current transformers, will reach 30,000 8 to 10 candle-power lamps. The company find that 8 to 10 candle-power lamps give very satisfactory lighting, and that if 16 candle power lamps are put in, the customer complains of the bill at the end of the quarter. The charge is made by meter—the Aron being generally employed.

The mains are laid underground on the Callender-Webber system. Their experience shows that when a separate channel is provided for each cable, as is the case in this system, long lengths of heavy cable can easily be drawn in or out. A cable, 2 in. in external diameter, 400 yards long, was recently drawn into a channel 2⅝ in. diameter



CHELSEA COMPANY'S SYSTEM—CURRENT CURVE, CLABON MEWS STATION.

without difficulty, the cable being drawn 200 yards each way from a central opening. Thirteen men were employed in pulling the cable in. If a separate iron pipe were employed for each cable the cost would be too great; and experience has shown that even if a large pipe is used the cables drag very heavily one on another if several are drawn into the same pipe. The charging mains are about two miles in length, and the charging e. m. f. reaches 2,200 volts. The boilers are the Babcock-Wilcox type of 100 horse-power nominal. The feed-water is supplied by a Worthington pump, and, in addition, injectors are fitted to each boiler in case of the pump failing from any cause.

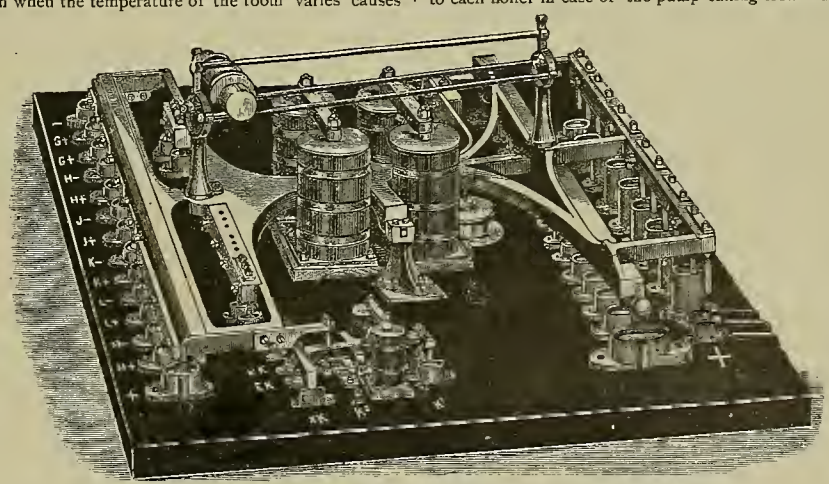


FIG. 2. CHELSEA COMPANY'S SYSTEM—TRANSPOSING SWITCH.

In this connection are given some supply curves taken from two of the sub-stations, a glance at which will show that the current consumed during the daytime—though it would result in a loss if it necessitated constant running of plant—yet bears no mean proportion to the whole supply, and might make all the difference between a good dividend and none at all.

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J. B. O'HARA, - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - Associate Editors.
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IN this issue is presented a continuation of J. A. Fleming's paper on Prof. Elihu Thomson's electro-magnetic induction experiments. As was stated in the discussion after the reading of the paper, these experiments were to some extent a repetition of those performed by Prof. Thomson himself at the Paris Exhibition. We will reiterate, though, a suggestion made last week. Let our readers not be contented with a mere perusal of the paper. Many have at hand the means for making simple experiments with alternating currents. The value of a knowledge obtained in this way will only be realized when the attempt is made to investigate the more complex phenomena.

FROM time to time mention has been made of the use of electric lights in Japan. Heretofore we had supposed that the work of introducing electric light on a large scale in Japan was the result of American enterprise. A correspondent of a New York paper, who writes from Tokio, has had new light on the subject. He makes this remark: "No city in the United States has a better system of electric lighting than Tokio. The exhibition of electric apparatus is superior and almost all of it is manufactured in Japan. Nearly all the civil and electrical engineers of the country are educated in America. There is no patent on the electric apparatus in Japan, and electric lighting is consequently almost as cheap as kerosene, which Sir Edwin Arnold says is the 'light of Asia.'" Some Jap, in all probability, has been imposing on the credulity of the correspondent.

THE Kansas City letter in this issue contains matter of considerable interest to municipalities considering the electric lighting question. A committee of Kansas City councilmen has been investigating this subject, and from its report it would seem as though it might not be a great while before that city would begin to imitate Chicago and have a plant of its own. The committee was most decided in its recommendation that the city control its own lighting system. From information received from other municipalities the committee reports that, generally speaking, the cost per light is less where the system is owned and controlled by the city authorities. Attention was also called to the singular fact that it found in those places where the greatest number of arc lights was employed for city lighting the highest price was obtained per light. The tables compiled by the committee are embodied in the Kansas City letter. The fact that the figures were obtained at a recent date makes the matter the more valuable.

ONE of the members of the Western Gas association has recently been interviewed in regard to a subject which has caused considerable interest in the National Electric Light association. In speaking of the papers read at the recent convention of the Gas association he said: "The discussion following the reading of papers was not as full and free as might have been expected. The papers were more than usually readable, but it is true that the discussions lagged. To get the best results, technical papers should be printed and mailed to members in advance, and time given for discussion. Papers are frequently read that contain entirely new and sometimes surprising matter, which the gentlemen present are not prepared to discuss. The object of these technical conventions is to get the benefits of an interchange of ideas, and I see no other way to secure the best results than to adopt my suggestion for the future." This plan was tested in a limited way at the Kansas City convention of the National Electric Light association, and several of the most interesting discussions were provoked by papers which were not read but were presented to the convention in pamphlet form.

BY the close of summer a large number of new electric roads will be in operation. The fact is referred to by *Bradstreet's* in this way: "The activity in street railway matters this spring has been unprecedented. More roads are building than ever before. More roads are projected. More roads are changing their motive power. More transfers of ownership have been made or are in progress. The chief cause of this is the spread of the belief in the economy and general desirability of the electric motor." The importance of these improvements in street car facilities in a city is referred to by a Cleveland paper which, in commenting upon the electric railways of that city, says: "Cleveland has had its share of all this, and here, as elsewhere, the great progress made during the last few months toward general rapid transit on street railways has had a marked effect in the building up of outlying residence territory, and in checking the tendency toward tenements and apartment houses. For this reason it is a most beneficent change in the conditions of life in large cities. The effect of better street railway facilities is more homes, in the best sense of the word, more fresh air and green trees for people of modest means, and a greater aggregate of comfort and happiness."

IN this issue is presented a description of a number of devices employed in the accumulator system of the Chelsea company, England. A number of sub-stations are located in the area to be supplied and each is furnished with a large storage battery. The set of accumulators in each station is divided into two parts, so that one half may be charged while the other is feeding the system. The cells are charged in series and the sub-stations are connected in series with the main or charging plant. By this means the advantages of a high tension charging current are secured. There are a number of features about the system which will prove to be interesting to accumulator exploiters on this side of the water. Apparently our English cousins are coming to the front in this line. It is stated that the present capacity of this station and sub-stations is about 10,000 lights but it is expected ultimately to supply current for 30,000 8 to 10 candle power lamps. The fact that the lamps used are only 8 to 10 candle power is surprising to an American, but it is stated that consumers are satisfied with the light obtained. The company finds that if 16 candle power lamps are put in the customer complains of his bill. In this connection we can not refrain from remarking that judging from this statement it is no wonder that electric lighting progresses somewhat slowly in England.

THE attention of the people of the country is regularly attracted to New York and its system of conduits by explosions in the subways. Last week's developments in this line were far more sensational than usual. As a result the people are crying for reforms, and the newspapers, as usual, are echoing the popular indignant protest. A prominent correspondent, writing on the subject, refers to the fact that the people are just now aroused, but adds they will in all probability soon lose interest in the affair. Continuing, he says: "It is now, however, only too plain a fact, even to the average indifferent citizen, that the method of laying pipes underground, and, also, the present method of managing the companies that lay these pipes, are nothing more nor less than criminal. These pipes have leaking spots all over the city. The steam heating conduits are a dangerous nuisance. And, as to the subways for electric light and other wires, they are poorly constructed, while the subway commissioners themselves are looked upon as unutterable dunces. What with gas volcanoes under us, subway manholes blowing sky-high at unpleasant intervals, and various other internal disturbances, the pavements of New York are not the safest surfaces in the world. It is only a question of time when a most serious disaster will visit this city—and it will visit us from below our dirty and ill-constructed streets."

THE action of Judge Wallace in the Kemmler case last week in remanding the prisoner to Auburn prison for execution by electricity, adds another to the already numerous complications in which the case has become involved. It will be remembered that the proceedings before Judge Wallace, by which the arrangements for the execution of the death penalty were overturned, were based upon the objections that the proposed move was unconstitutional. In granting the application for a writ of habeas corpus Judge Wallace said that it was with the explicit understanding that the case would be immediately brought before the Supreme court of the United States for decision as to the constitutionality of the law. The Supreme court declined to hear the application for a writ of habeas corpus for the reason that it could not regularly take notice of an original writ in such a case. Judge Wallace had made no decision on the writ, and therefore there could be no appeal upon which to allow the Supreme court to act in its appellate capacity. For the purpose, however, of securing a speedy determination of the question involved the court directed that an application be made for a writ of error from the findings of the Court of Appeals of New York. This was done and the questions at issue were passed upon, the court refusing to sustain the objections of Kemmler's counsel. Now, however, that Judge Wallace has made a ruling Kemmler's counsel undoubtedly has a legal right, it is stated, to appeal again to the Supreme court, thus delaying the execution, but as the Supreme court has already passed upon the case, though through a different proceeding, no further advantage could be obtained. It is, therefore, hardly possible that this course will be pursued. Counsel for the condemned man has already begun proceedings on a different plan, setting up the claim that the provision of the new law naming the warden of the state prison the executioner in place of the sheriff is unconstitutional. This will practically reopen the case and delay the final decision.

Prof. Elihu Thomson's Electro-Magnetic Induction Experiments.[1]

By J. A. Fleming.

Part II.

One of the most beautiful of Prof. Thomson's experiments illustrating this repulsion can, I think, be shown to you now.

An incandescent lamp is attached to the terminals of a coil of wire, and the coil and lamp floated in water or hung from a scale beam, Fig. 24, over the pole of an alternating magnet. The coil and lamp form, as it were, a balloon and car floating in space, and placed in a magnetic field. When that magnetic field is rapidly alternated by exciting the magnet, the induced currents created in the coil make

FIG. 24.

themselves evident by illuminating the lamp, and the repulsive electro-dynamic action shows itself by lifting the lamp and coil upward through the water or the air.

The same experiment renders it possible to show the effect of magnetic screening very prettily. If I introduce a plate of copper between the magnet pole and the induction coil attached to the lamp, the copper "screens" the coil from the inductive action of the pole, and the light of the lamp disappears. I must next direct your attention to some curious effects which are found to exist when two conducting circuits are exposed to the magnetic flux from an alternating magnetic pole, and which depend upon the inter-action of the currents induced in each respectively. Prof. Thomsom embodies these facts now to be considered in four laws, which may be briefly stated as follows:

1. If two or more closed circuits are similarly affected inductively by an alternating magnetic field they will attract one another, and tend to move into parallelism.

2. Iron or steel masses placed in an alternating field give rise to shifting magnetism or lines of force moving laterally, and may, therefore, act to move closed circuits in the path of such shifting lines.

3. Closed circuits in alternating magnetic fields or fields of varying intensity give rise to shifting magnetism, or lines of force moving laterally to their own direction, and may therefore, act to move other closed circuits in the path of such lines.

4. Iron or steel masses may, when placed in an alternating magnetic field, interact with other such masses, or with closed electric circuits, so as to produce movement of such masses or circuits relatively, or give rise to tendencies to so move, the effects depending on continual adaptations of shifting magnetism and retained magnetism relatively.

It is a simple matter to illustrate these principles; and the experiments, which are designed so to do, bring before us some striking peculiarities of the action of magnetic force upon closed circuits, and upon masses of conducting and magnetizable matter.

Returning, first, to the simple experiment of a copper ring repelled by an alternating pole, we find that if we add a second ring under the first, they both attract one another, and the two rings are supported and repelled as if they were one ring. It is obvious that at any instant the induced currents in both rings are in the same direction, and hence they attract one another.

Such an attractive action can be made to produce continuous rotation. We have only to place a copper ring or plate over the alternating current coil or pole, and then bring a copper disc, free to revolve on pivots, into proper position relatively thereto. This can best be done by placing the ring or plate so as to be somewhat to one

FIG. 25.

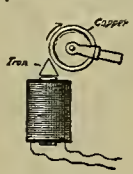


FIG. 27.

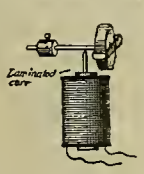


FIG. 28.

side of the pole, so as to "shade" part of it, as it were, while a part of the pivoted disc is placed under or over it, in front of the alternating pole. The disc then begins to revolve rapidly on its pivot, Fig. 25. A little consideration shows that in this case the fixed copper plate shields a portion of the pivoted plate. The currents induced in the fixed plate attract the non-symmetrically placed induced currents in the other disc, and exert a tangential action or couple upon it, tending to pull it round. The continual

1 Read before the London Society of Arts, May 14, 1890.

repetition of this action, as each portion of the plate becomes in turn the seat of maximum inductive action, results in a continual revolution of the plate. Two pivoted discs may be used instead of one, and it will be found that they may each "shade" a portion of the pole, and if made to overlap, they will pull each other round and revolve in opposite directions when the alternating pole acts upon them.

This principle of "shading" a portion of the magnetic pole, and hence causing an unsymmetrical distribution of induced currents in a conducting body, capable of revolution on a pivot, has been developed by Prof. Thomson in many extraordinary ways.

Floating, for instance, a hollow sphere of copper on the surface of water in a glass vessel, he places this over an alternating magnetic pole. If the pole is placed directly under the sphere, the electro-magnetic action would, as before explained, result in a repulsive force acting upon the disc. If, however, a sheet of copper is placed half over the pole, so as to "shade" a portion of the copper sphere, the currents induced in it are unsymmetrically situated with respect to its center, and react upon the current induced in the plate. Hence, the electro-magnet action resolves itself into a torque or couple, causing the ball to spin rapidly upon its center, and take up a rapid rotation. So considerable is the rotational force brought to bear that the ball will rotate when merely laid on a sheet of copper, even overcoming the friction of such rotation on its equatorial line, provided that the ball and supporting plate are so held over an alternating pole that the plate shields a portion of the sphere, Fig. 26. Given this principle, that by properly "shading" a pole from a portion of a solid body capable of revolution round a line or axis, it is easy to see that countless forms of electromotor can be designed.

A sort of anemometer, with copper discs for cups, resembling the cross of a Crooke's radiometer, can be set in rapid rotation by an alternating pole, if a copper screen is placed so as to shade one side of it.

This unsymmetrical development of the induced currents can be produced by a suitable disposition of the magnetic pole alone. Thus we may place a cone or wedge of iron on the alternating pole, and hold near it a copper ring mounted so as to be able to revolve, Fig. 27. The copper cylinder or wheel revolves rapidly under the action of the periodic field, and its direction of motion is such that it seems to be blown around by a blast from the end of the magnetic cone. Prof. Thomson has constructed a curious electrical gyroscope as follows: A vertical pivot projects from the center of an alternating pole, Fig. 28 upon which is pivoted a horizontal rod bearing a counterpoise, and a copper wheel, preferably with an iron core attached to it, gyroscope fashion, by means of a copper frame. The copper frame is placed in an inclined position with respect to the horizontal. Under these circumstances a vigorous rotation is communicated to the gyroscope wheel when the

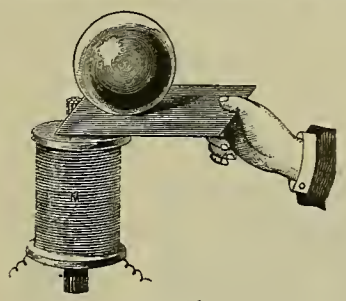


FIG. 26.

alternating field acts upon it. The copper frame shields one side of the wheel more than the other, and as a result, the induced currents in the copper wheel are unsymmetrically placed with respect to its axes of rotation, and it experiences a violent torque.

These experiments can, by a little ingenuity, be endlessly multiplied when once the fundamental principle is grasped. Bodies can be made to rotate and move, taking their movements from the magnetized space in which they are placed, and without being supplied with current from an external source.

Prof. Thomson has, however, studied some curious cases of magnetic motion, in which rotations are obtained when iron or copper pivoted discs are placed near to iron or steel bars, in which the propagation of magnetism is throttled by closed circuits. If a longitudinally laminated iron bar has a closed copper band or coil placed round it at one point, and if such a bar is made magnetic by a periodic current traversing a magnetizing coil embracing another part, this structure becomes capable of rotating iron or copper discs held near it. The explanation of this effect is probably to be found in the fact that the closed embracing coil tends to throw off the magnetic lines of force laterally at that point. Consider a bar, Fig. 29, *A B*, in which lines of magnetic force are being established in the direction from *A* to *B*. That is to say, let magnetic induction be increasing in the bar in a direction from *A* to *B*, at *C* let there be a closed coil embracing the bar, the magnetic induction during its period of increase is setting up in this circuit an electromotive force which establishes in the circuit a current whose lines of force are opposed to the primary induction inside the coil, and therefore, in the iron included in the coil, but in the same direction outside the coil, and therefore, outside the iron. The result is as if the lines of primary magnetic induction in the iron were shed off laterally and escaped round the coil. When the magnetic induction in the iron, due to the magnetizing coil, is made periodic, this action will create a kind of lateral pulsation of the magnetic lines of force in the neighborhood of the closed coil. If, then, a movable conductor is held near such a magnetically-throttled bar, it will be subjected to a displacement of lines of magnetic force through it laterally, and will hence have eddy electric currents generated up in it. These currents, persisting into the period of reversal of the field in virtue of self-induction in the conductor, will cause the portion of the conductor in which they are set up to be continuously repelled, and hence to take up a motion of rotation. A ring of cast-iron, having a closed coil wound on it at one point, is held so that another point on its circumference, 90° removed from the closed coil, is on the pole of an alternating magnet. An iron disc, centrally pivoted and held concentric with the ring, is rotated when the magnet is energized by an alternating current. It is not even necessary to have a closed coil on one part of the active magnetic bar, provided that this bar is not laminated, or, better still, is made of hard steel. In these cases there is a lag in magnetization, due to either eddy currents set up in the bar or to hysteresis, and the result is a lateral escape of lines of force out of the bar. When it is held with one extremity on an alternating magnetic pole, there is in these cases an action which is a true "magnetic self-induction." In the case of electric circuits, if we join in parallel two circuits, one having very small ohmic resistance and very high self-induction, and the other very large ohmic resistance and small self-induction, a sudden flow of current chiefly selects the path of least self-induction for its flow during the variable period, although during its steady period it will chiefly flow by the path of smallest ohmic resistance; so in the case of a magnetic and conductive cir-

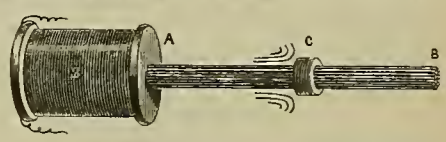


FIG. 29.

cuit of low magnetic and electric resistance (iron), shunted by a path of high magnetic and electric resistance (air), rapid variations of magnetic induction bring about a state of things in which the magnetic induction seems to chiefly select the path not of least but of greatest magnetic resistance during the variable period. Time will not permit me to develop at greater length the analogies of the magnetic and electric circuits under the conditions of rapidly periodic magnetic induction and electric current; but there are many suggestive ideas which arise when we place before our minds the notion of a magnetic self-induction which is the consequence of a time element coming into action in the setting up of induction in a magnetic and conductive circuit, and due to the production of electric eddy currents, just as the electro-magnetic or ordinary self-induction is the consequence of the time element coming into action in the setting up of an electric current, and due to the production of a surrounding magnetic field. Just as the rise of current strength under an impressed electromotive force, acting in a conducting circuit, is retarded by linking that conductive circuit with a magnetic circuit, so the rise of magnetic induction under an impressed magnetizing force acting on a magnetic circuit is retarded by linking that magnetic circuit with an electric conducting circuit. I am under the impression that Oliver Heaviside has developed these notions in a mathematical form, but am unable at the moment to place my hands upon the results. The effect, however, of a bar of unlaminated iron when surrounded by a magnetizing coil at one end, and traversed by a periodic current, is to cause rotation in copper or iron pivoted discs held near it, or when such a bar of non-laminated iron is abutted on the pole of an alternating magnet. A bar of steel, even if not laminated, is able to cause brisk rotations in copper or iron discs under the same circumstances With hardened steel the action is more marked. Here the hysteresis retards the propagation of the magnetic wave. By laying a large file flatwise against the alternating magnetic pole at about the middle of the file, discs of copper or iron may be kept revolving if held over those portions of the file which project from the pole of the magnet, Fig. 30. In this case the magnetic retardation in the bar is brought about by its own physical structure, and not by embracing it with a closed conducting circuit. The result is, however, the same in kind; there is a sluggishness in the establishment of the magnetic induction on the steel or iron under the action of magnetizing force, which partly depends on the eddy currents in the mass of metal, and partly on hysteresis. As a consequence, we have a periodic lateral displacement of the field. The question of a magnetic leakage depending on a retardation of induction deserves special attention in the case of commercial alternate current transformers. Time will not permit me to enlarge on it here to any great extent; but I may observe that in the design of closed-iron circuit transformers this magnetic leakage should not be neglected.

In a closed iron circuit embraced at one part by a magnetizing coil, and subjected to rapidly reversed magnetic force, the magnetic induction does not confine itself wholly

FIG. 30.

FIG. 31.

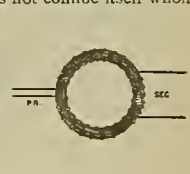


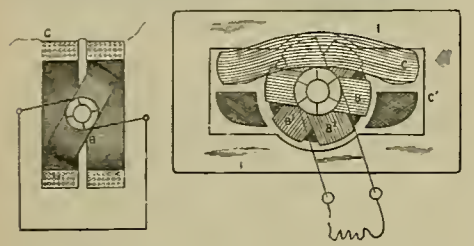
FIG. 32.

to the path of least magnetic resistance, viz., the iron path, but takes a short circuit in part across the interior air space. This waste field may, in badly designed transformers, be something considerable. I believe that an important point to hold in view in transformer construction is to subject the iron circuit uniformly to the magnetizing force, by embracing all portions of the iron circuit with primary windings, and not locating the windings simply at one part. There is then a tendency to check the production of waste field by the lateral bulging out of the magnetic lines of

force from the iron. In Fig. 31 is a diagram illustrating the arrangement of primary and secondary coils, most favorable for the production of waste field, and in Fig. 32 the arrangement least favorable for the same.

The foregoing experiments are of such a nature as obviously to force on us the thought that useful and perhaps important applications can be made in electro-magnetic machinery. Prof. Elihu Thomson has, as you can imagine, not been slow to do this; for in him is united both a keen scientific sagacity and that clear mental vision, which enables him to pursue to its logical issue in practice the consequences of scientific discovery. He has already applied these principles to the construction of alternating current indicators, alternating current arc lamps, regulating devices for alternating currents, and to rotary motors for such currents. For current indicators, a pivoted or suspended copper band or ring, composed of thin washers piled together and insulated from one another, and made to carry a pointer or index, has been placed in the axis of a coil conveying alternating currents, whose amount or potential is to be indicated. Gravity, or a spring, is used to bring the index to the zero of a divided scale, at which time the plane of the copper ring or band makes an angle of, say, 15° to 20° with the plane of the coil. This angle is increased by deflection more or less great, according to the current traversing the coil. The instrument can be calibrated for set conditions of use. Time would not permit of a full description of these arrangements as made up to the present.

In arc lamps the magnet for forming the arc can be composed of a closed conductor, a coil for the passage of cur-



FIGS. 33 AND 34.

rent, and an iron wire core. The repulsive action upon the closed conductor lifts and regulates the carbons in much the same way that electro-magnets do when continuous currents are used. The electro-inductive repulsive action has also been applied to regulating devices for alternating currents, with the details of which I cannot now deal.

For the construction of an alternating current motor, which can be started from a state of rest, the principle has also been applied, and it may here be remarked that a number of designs of such motors is practicable.

One of the simplest is as follows: The coils, *C*, Fig. 33, are traversed by an alternating current, and are placed over a coil, *B*, mounted upon a horizontal axis transverse to the axis of the coil, *C*. The terminals of the coil, *B*, which is wound with insulated wire, are carried to a commutator, the brushes being connected by a wire, as indicated. The commutator is so constructed as to keep the coil, *B*, on short circuit from the position of coincidence with the plane of *C*, to the position where the plane of *B* is at right angles to that of *C*; and to keep the coil, *B*, open-circuited from the right angled position or thereabouts to the position of parallel or coincident planes. The deflective repulsion exhibited by *B* will, when its circuit is completed by the commutator and brushes, as described, act to place its plane at right angles to that of *C*, but being then open-circuited, its momentum carries it to the position just past parallelism, at which moment it is again short-circuited, and so on. It is capable of very rapid rotation, but its energy is small. He has extended the principle to the construction of more complete apparatus. One form has its revolving portion or armature composed of a number of sheet-iron discs, wound as usual with three coils crossing near the shaft. The commutator is arranged to short-cir-

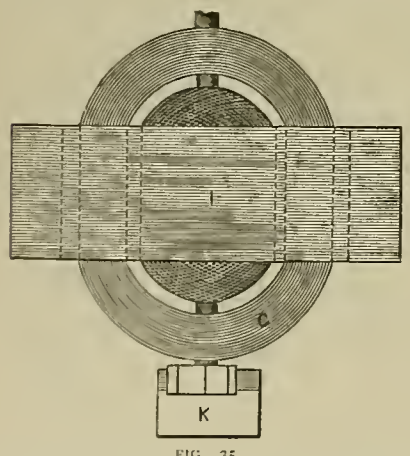


FIG. 35.

cuit each of these coils in succession, and twice in a revolution, and for a period of 90° of rotation each. The field coils surround the armature, and there is a laminated iron field structure completing the magnetic circuit.

In Figs. 34 and 35 we have diagrams which will give an idea of the construction of the motor referred to. *C*, *C* are the field coils or inducing coils, which alone are put into the actuating alternating circuit. 1, 1 is a mass of laminated iron, in the interior of which the armature revolves with its three coils, *B*, B^2, B^3, wound on a core of sheet-iron discs. The commutator short-circuits the armature coils in succession in the proper positions to utilize the repulsive effect set up by the currents which are induced in them by the alternations in the field coils. The motor has no dead point, and will start from a state of rest and give out considerable power, but with what efficiency is not yet known. A curious property of the machine is that at a certain speed, depending on the rapidity of the alternations in the coil, *C*, a continuous current passes from one commutator brush to the other, and it thus performs the function of converting some electric energy from an alternating to a continuous form.

A small motor of a curious type has been made, utilizing the principle of "shading" the pole by closed circuits. A

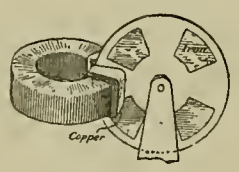


FIG. 36.

laminated ring, Fig. 36, is wound over with wire, but has a slot cut through it, dividing the ring, and causing it to present two pole-faces opposite to each other at the cut part. Each pole is arranged by a set of closed copper bands to be "shaded." A copper disc, free to turn on a shaft, is introduced by one edge into the air gap in the magnet, and turns rapidly when the magnet is excited. A silver coin held just at the edge of the air-gap in such an alternating magnet with shaded poles, is drawn into the interpolar space and propelled with some force through the same; but a lead disc or coin of base metal is not acted upon nearly by the same force, owing to its inferior conductivity. I have left myself but little time to speak of numerous applications of these principles in alternating current meters. The well-known meter of Mr. Schallenberger was described to you here quite recently by Prof. Forbes. There is, however, a new form of meter, designed by Messrs. Wright and Ferranti, which exhibits in a most beautiful manner a practical application of some of these principles which have briefly occupied our attention. In Fig. 37 we have a diagram of this meter. It consists in its latest form of a pair of vertical electro-magnets—magnets having divided iron cores. To the poles of these magnets are attached curved horns of divided iron, which lie in a horizontal plane. These curved horns are magnetically throttled at intervals along their length with copper bands. The curved horns embrace a circular space, in which can revolve a light copper or iron shallow cylinder of thin metal. This cylindrical band forms the periphery of a light wheel capable of rotation on a vertical axis. Geared to this axis is a counting mechanism. The axis also carries a vane having mica blades. The electro-magnetic principle may be briefly described thus: The throttling of the curved iron horns causes the rapidly reversed magne-

FIG. 37.

FIG. 38.

tism to take the form of a lateral diffusion of lines of force from the sides of the horns. In effect, a series of oppositely-named magnetic poles travels along the horn from the base, where it is in contact with the top of the electro-magnet, to the tip. These poles are represented by a series of bunches of lines of force setting out laterally from the sides of the horn, and traveling up it. The lateral passage of these lines of force through the metal band which forms the rim of the movable wheel generates in it eddy currents. These are continually repelled by the moving field producing them, and hence a motion of rotation is given to the wheel by the alternating magnetism of the magnetic poles. The speed of rotation, being retarded suitably by the vanes, can be made to be proportional to the current strength of the current exciting the magnets, and hence the total turns of the wheel in a given time to the total electric quantity flowing through the meter. A beautiful adaptation has here been made of the principles we have been briefly studying, and much more might be said in explanation, or rather, in elucidation of the action of this meter did opportunity permit.

It would take me beyond the limits of the time during which I am permitted to trespass upon your attention, if I were to attempt to exhaust the list of electro-motor applications that have been made of these electro magnetic repulsions. That is a subject important enough to deserve a separate treatment. In Berlin, not long ago, I saw a most ingenious form of self-starting alternating current motor, the invention of Herr von Dolivo Dobrowolsky, in which the rotating portion was merely a solid iron cylinder constituting a commutatorless armature, revolving in an alternating field, and which acted in a perfectly marvelous manner. The region of practical invention here opened is a very wide one, and I have, therefore, ventured to direct your thoughts to it to-night, confident that its character in this respect deserves all the attention it can obtain, and that a firm foundation for such work is laid in these interesting researches of Prof. Elihu Thomson.

Gas Man's Opinion of Electric Lighting.

At the recent annual meeting of the Western Gas association at St. Louis, President Charles R. Faben in his annual address devoted considerable attention to the development of electric lighting and its relation to the gas interests. His remarks will prove interesting especially in view of the fact that some gas men persist in the statement that the electric light is in an experimental stage, and superior in no respect to gas lighting. The official report of the president's address furnishes the following passages:

"The electric light as a competitor to gas, for purposes of light, presents a solid front. The arc light has established itself as the best means of lighting large areas, and for street lighting purposes it has no equal. The incandescent electric light is making good fair progress in many places, and I might say generally. It presents some few advantages over gas that the promoters never fail to appreciate, and they always call the attention of possible patrons to these various little advantages. A naked flame is a dangerous thing to have exposed in many situations where gas jets have been used; but with the incandescent electric lamp quite a display is often made in show windows, stores and private houses, with the light placed and distributed in some unusual manner, the effect of which is novel, and at once taking to the average person.

"How very profitable to investors these electrical undertakings may be, I question. From statements recently made, I find that out of about 100 electric lighting companies in Massachusetts only 15 declared dividends in the past year. Of these 15 companies 10 declared dividends of from 1 to 6 per cent, and only 5 declared dividends above 6 per cent. Leaving out the Boston companies, which, by reason of the extent and value of their territory, enjoy a greater demand for their light than exists in smaller places, the average dividends paid by the electric light companies in the state, who paid dividends at all, has been only 4.9 per cent.

"Another fact in this connection is that no fund has been created by these several electric light companies to compensate for wear and tear. No depreciation has been charged off. The usual and necessary repair is supposed to represent all of the depreciation, so that the dividends paid are virtually taken from the plant itself, or its value. Electric light companies are, as a rule, opposed to having any depreciation charged off other than the cost of repairs and renewals actually made.

"The use of incandescent electric light has demonstrated to my mind the tendencies of the times in the matter of distribution of light. A few years ago many consumers of gas complained of the light produced from burning gas, that it was not of sufficient intensity, and they resorted to the arc light. In many of these situations since that time, the arc light with all of its intensity and other desirable qualities, has been discarded, and a great number of incandescent electric lamps are used in its stead, so that the present tendency seems to be in the direction of the use of a large number of small lights for indoor illumination, giving to the general illumination something more of a starry effect.

"The custom and practice with incandescent electric light companies, in the matter of computing and establishing rates for lighting service, is certainly faulty. No matter how careful and conscientious a consumer may be, the privilege of the free and unlimited use of an article of light leads to great wastefulness. This wastefulness is an item of expense to some one, and, under the conditions cited, it must be a very serious item to the producer.

"The question of whether or not gas light companies should engage in the supplying of electric light, is a purely business proposition, and is determinable only by local conditions. In some situations, yes; in others, no."

Interior Conduits.

At the present time much interest is taken in every new plan for the insulation and protection of electric wires. A little pamphlet has just been issued by the Interior Conduit & Insulation company of New York City, which describes in a most interesting way its method of disposing of conductors and conduits. A portion of this description is appended. The company's president is Edward H. Johnson; the vice-president, Sigmund Bergman; the secretary and treasurer, W. A. Willard; and the electrician Edwin T. Greenfield. Following is an abstract from the pamphlet:

"All insulations which can be so affixed are of necessity compounded of oils, gums or other flexible and adhesive materials, all of which are readily affected by heat. Vain efforts have been made to find a new elementary material, or to compound known materials which shall have the multifold property of high insulation, great resistance to heat, extreme flexibility and proof against acids, gas, etc. The great value to the art of an insulation possessing these naturally diverse qualities has been of late years so keenly appreciated as to concentrate the inventive mind on the line of its pursuit to the exclusion of any consideration of other methods of protecting the wires. This is the only explanation of the failure of the inventors to evolve a natural and effective solution of the problem. Necessity has been well said to be 'The Mother of Invention,' and it was by virtue of the necessities of himself and the numerous friends who depended upon him for advice in such matters that Edward H. Johnson was led to suggest the total abandonment of the old practice, and the substitution therefor of an inclosing tube, separate from, but forming a channel for conducting wires, continuous throughout their every ramification, thus fully protecting every inch of wire and rendering it accessible for periodic inspection or renewal, and by the same means absolutely confining within the safe limits of a non-inflammable channel the possible heat development.

"The practical efficiency of such a method scarcely needs to be supported by argument or demonstration. Its very simplicity appeals at once and alike to the intelligence of the expert and the layman.

"The elimination of the element of extreme flexibility as

an essential requisite of insulation simplifies the problem, and permits of the employment of a variety of materials not at all available in the practice of affixing the insulation to the wires. Thus the door is opened and the inventor now comes forward to provide the requisite perfection of detail. In this respect the industry is extremely fortunate in the chance which has brought to its aid Edwin T Greenfield, a man of wider experience in the old method, and therefore more keenly appreciative of its weakness, than any man in this or any other country; to the thoroughness with which Mr. Greenfield has done and is doing his work is due the already high perfection of the new method and the guarantee that it will at once afford superlatively the elements of safety, economy, durability and convenience.

"In further pursuance of the conditions of safety, Mr. Johnson has incorporated with the new system a special conductor upon which he has been at work for some years, the function of which is to convert conditions favorable to a prolonged heat presence into conditions of instantaneous action hereinbefore described as a factor of safety.

"This conductor is so constructed as to convert all defects which may develop in the wires, such, for illustration, as a break, a leak, an imperfect union or other faults common to all systems of energy distribution and which is technically known as a 'short circuit.' This is a fault which develops instantaneously an abnormal concentration of energy and in consequence effects the immediate destruction of the weakest link in the chain which supports the current. Much has been said and written of the device known as the 'safety fuse,' and rules and regulations enforcing its use are universal. It is introduced as a link in every electrical chain and is designedly made the weakest link therein—hence a 'short circuit' simply means the destruction or giving way of this link, thus insuring by the breaking of the chain the total and absolute cessation of the electric current previously supported thereby. This weak link is, of course, located within safe pockets where the somewhat violent results of its disruption are smothered or otherwise rendered abortive.

"Contrary however, to popular belief, this device does not provide absolute protection. Its failure to do so arises from the fact that it is only affected by an overloading of the chain It is, of course, apparent that a partial break, an imperfect union or a leakage of the current may develop a sufficient degree of heat to effect the ignition of inflammable materials, and yet not sufficiently increase the current strength to overload and fuse the safety link. The object of the special conductor herein alluded to is to convert with absolute certainty all defects, whether a break, a leak or other fault into a 'short circuit' and the consequent overloading and fusing of the safety link. The effect of a 'short circuit' is generally apparent at the point of its occurrence in the form of an instantaneous flash, hereinbefore alluded to as ineffective of much damage because of its brief duration. It is possible, however, to have present conditions of extreme inflammability, as for instance gases, inflammable powder, as in a flour mill, lace or other delicate fabrics, or even the insulation of the wires themselves. It therefore becomes a matter of considerable importance to safely localize even this flash, and it is obvious that the inclosing tube does this to perfection, in that every inch of the wire is completely encased within the safe confines of its fireproof interior.

"In finding a solution of the problem of insulating and protecting wires for interior use, the equally vexed problem of protecting and insulating wires underground has also been solved, demonstrating that the problem of electrical distribution, whether interior, aerial or underground, is one and the same, and may all be comprehended in two words, viz.: Insulation and accessibility. The high insulation, low cost, great durability and flexible character of the company's safety tubes, suggested at once their fitness for forming ducts for underground conduits, whereupon a special size and weight of tube was made and at the same time a system of laying and sealing them so as to completely exclude moisture, gases, etc., was thoroughly worked out. The system thus devised has met with high approval and prompt acceptance, and is being rapidly introduced throughout the country."

Street Lighting in the United States.

A circular has been issued by the Oakland (Cal.) Gas, Light & Heat company containing statistics on street lighting in the United States, gathered by the publishers from the lighting companies in the cities listed. It is not strange, in view of this fact, that errors have found their way into the work, but there appears no excuse for the evident hostility to electric lighting, which marks the conclusions drawn by the compiler. The acknowledgment that "electricity has established itself as a method of street lighting," is of interest when it is considered the figures furnished in the report show that 65 cities are lighted by electricity alone, as against 21 cities in which gas retains absolute sway. Moreover there are 63 cities in which gas has been obliged to share the patronage with electricity. Four cities use the tower system exclusively, while 19 combine the towers with single lamps, and 100 employ single lamps on poles or arms. The Thomson-Houston system is used in 62 cities, the Brush in 23, while all other systems combined are represented in 43 cities. The report concludes: "As a conclusion from the facts above set forth it is safe to assume: 1st. That electric lighting for cities by means of single lamps is the most effective system. 2d. That a combination of gas and electricity gives the best results for the least money. 3d. That electric lighting is 50 per cent. more costly than gas." It is furthermore urged that replies to queries indicate that "if the same amount of capital invested in lighting cities by electricity was expended in gas more satisfactory results would be obtained." It would be interesting to learn from what sources these replies came. The absurdity of the claim in the face of facts is too apparent to require any extended notice. Gas men of experience acknowledge the superiority of the arc system for street illumination and those who are abreast of the times are combining as rapidly as possible the two systems. It is too late in the day to combat the supremacy of electric lights for street illumination In fact many managers of gas companies—and it might be noted they include the most sagacious and successful in the country—have taken a step further and introduced incandescent plants as well as arc systems in conjunction with their gas works.

Another point which is made in the report is the comparative increase in the cost of city lighting where electricity has been introduced. It should be borne in mind that in most of the eastern cities where electric lights were introduced they were substituted on the principal streets for gas lamps, and these were removed to the outskirts which had been supplied with oil lamps or not lighted at all. In one eastern city in particular in which it is stated the cost was increased three-fold by the introduction of electric lights, there are many important facts omitted from the report. In the first place the city was never before properly lighted, many residence streets having no light whatever. Now, however, the electric lights extend to the city limits and incandescent lamps are used in unimportant cross streets, etc., and there is twice as much territory supplied with light as under the old regime. The people appreciate the advantage they received in the introduction of electric light and the few remaining gas lamps are being replaced as rapidly as possible by the superior illuminant. The Flower City is considered the best lighted in the country and if the question were put to a popular vote the probability is the present cost could be materially increased rather than return to the old order at the reduced expense.

Western Power Construction Company.

The Western Power Construction company has been organized by Chicago capitalists, with paid-up capital stock of $500,000 The headquarters of the company will be in Chicago. The company will confine its business principally to the construction of power plants for electric light and railway companies, from the Alleghany mountains to the Pacific coast. It will serve all systems alike in this respect, having no connection with any particular company, but being in the field for business from whatever quarter it may come. A specialty will be made of the MacIntosh & Seymour engine. Strange as it may seem, it is believed to be the only power construction company in Chicago devoting its efforts solely to erecting electric power plants. It certainly has a big field, and that the venture will be a success cannot be doubted. The general manager of the company is W. P. Adams, whose experience in electric and steam engineering is amply sufficient to justify his appointment to so responsible a position The company's main offices are at 144 Adams street, Rookery building. J. E. Wilson, formerly representing J. A. Grant & Co. of Boston, takes a prominent position with the new company.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 14.—The terrific electric storms of the week and the unusually heavy rainfall have caused much damage to electric wires and plants in the vicinity of New York and several serious accidents are the consequence. The Manhattan electric light plant at Eightieth street and Avenue B was greatly damaged by lightning which struck one of the wires and followed it into the building setting fire to a switch-board. The building is almost new and as nearly fireproof as the better class of buildings in New York but there was enough combustible material to make a lively fire. There are 26 dynamos valued at from $3,000 to $5,000 each which were damaged, the aggregate loss amounting to about $40,000. All the commercial district north of Eightieth street is lighted by the Manhattan plant, and the down town lights along Broadway as far as Leonard street; also 89 city lights. The turning off of the lights will be only temporary, as the damaged plant will shortly be in working order again.

A horse valued at $3,000 was instantly killed at Plainfield by stepping on a high tension wire that had become loosened and fallen to the ground. The driver received a shock also. A suit against the Plainfield Electric Light company has been begun to obtain the value of the horse which was killed.

The gas mains, the steam heating pipes and the electrical conduits at the corner of Fulton street and Broadway gave a pretty fair demonstration Thursday of the danger that lies directly beneath our feet by such an explosion of manholes and pouring forth of blazing gas and steam that one could easily imagine himself at the crater of a volcano in eruption. Eight gas mains met at this point; the subway on the east side holds six of the United States company's cables and two of the Mount Morris company's, while the Steam Heating company's pipes are beneath all. It is said that the fault is due to the failure of the steam heating trenches to support the earth above. The gas mains in consequence sagged, and leaks occurred which becoming ignited, explosions followed. The electric cables were greatly damaged and there was serious hindrance to traffic for nearly 24 hours by the lighted gas which blazed up to a height of eight feet at times. The mayor visited the scene with Chief Engineer Birdsall of the Public Works Department and Engineer Kearney of the Board of Electrical Control. The mayor called a meeting of the Board of Electrical Control for Tuesday to make further inquiry into the matter.

The ablest counsel support the Rapid Transit commission in the determination to find a route through the city in spite of the number of enactments on rapid transit and the seeming barring of several streets. It is now settled that Forty-second street is free for the use of the commissioners whether they wish to build above, below or through it. The proposed route is now determined upon rather definitely and the report will be presented June 21.

Judge Cephas Bogart is endeavoring to settle with the Passaic, Garfield & Clifton Electric Railroad company for $10,000 damages to his property by running the overhead system on the side of the street instead of the center. The electric company think that the road will enhance the judge's property 25 per cent, but are willing to allow him $1,000 for seeming damages.

It is reported that a syndicate of Philadelphia capitalists has subscribed $8,000,000 for investment in street railways in Newark, Buffalo and Rochester in addition to many miles of electric roads which it now owns in these cities. The city council of Elizabeth has granted this syndicate a franchise to extend a branch from Newark to the Elizabeth race track and quite a valuable territory is thus covered. These great combinations to secure electric traction are proving sources of profitable investment.

Michael Abrahams, a messenger boy in the service of the Mutual District Messenger company, secured a verdict of $4 against his former employers in a civil action last week. The lad had been intrusted with the delivery of a huge glass sign which he had the misfortune to demolish. The company deducted $4 from the lad's wages, and he immediately began an action to recover, with the result mentioned.

Judge Wallace has vacated and dismissed the writ of habeas corpus in William Kemmler's case. In the order he recites the facts of issuing the writ, and now, since the Supreme court of the United States has decided that the sentence under which Kemmler is held is due process of law and that he is not held and detained contrary to the constitution of the United States, the writ is recalled and dismissed, and Kemmler remanded to Warden Durston's custody in order that the judgment of the Court of Oyer and Terminer may be duly executed.

W. H. T.

Kansas City, Mo.

KANSAS CITY, Mo., June 14 —The greater part of the time at last week's sessions of the council was taken up in a consideration of the report of the joint committee on the relative cost of street lighting in the various cities of the country. The report was adopted by the upper house. The lower house referred it to the finance committee and city comptroller. The committee reported that "Kansas City is lighted by four private companies—the Kansas City Gas Light & Cable company, the Kansas City Electric Light company, the American Electric Light company and the Missouri Valley Vapor Light company. The electric light plant is owned by the two companies, and the city makes contracts with them for lighting monthly. In order to fully inform the council what is being done in other places we submitted the following questions to about sixty cities, from whom we received replies. The questions were in regard to electric lighting: 'Is the plant owned by city or private company? How many street lamps are maintained? What is the candle power? Are they lighted every night and all night?'

"The use of gas for lighting streets is rapidly being discontinued, but many cities, like our own, are fettered with unexpired contracts. That gas will not continue to hold even its present position is shown by the number of important places that have entirely abandoned it, among which are: Akron, O., Duluth, Pittsburg, Pa, Columbus, O., Galesburg, Portland, Denver, Los Angeles, St. Joseph, Detroit, New Orleans, Salt Lake City, Galveston, Peoria, Ill., and Sedalia. * * * There has been appropriated to the gas fund for the year 1890 the sum of $95,000. Without putting in any more lights than we had on June 2 the lighting of the city for the current year will cost as follows:

For gasoline	$37,800
For gas	30,620
Electric lights	24,291
	$92,710

"It is therefore imperative that no ordinances should be passed for more light. The most we can do is to see that mains for gas are laid on streets before paving is done and defer lighting.

"Turning now to electric lighting we present a table of cities which are lighted by private companies:

Name of City.	Schedule.	Number of Lights.	Cost per Night, in cents.	Candle Power.
Kansas City	All night	114	55	2,000
Atlanta, Ga.	All night	596	53½	2,000
Baltimore, Md.	All night	607	40	2,000
Binghamton, N. Y.	All night	123	36	2,000
Birmingham, Ala.	All night	100	23	2,000
Buffalo, N. Y.	All night	1,296	40	2,000
Cleveland, O.	All night	100	38	2,000
Denver, Colo.	All night	216	53	2,000
Duluth, Minn.	All night	156	35	2,000
Jackson, Mich.	All night	210	24	2,000
Lowell, Mass.	All night	180	50	2,000
Memphis, Tenn.	All night	100	50	2,000
New Bedford, Mass.	All night	90	40	2,000
New Haven, Conn.	All night		48	2,000
Richmond, Va.	All night	134	40	1,200
St. Louis, Mo.	All night	1,587	20½	2,000
Sedalia, Mo.	Moonlight	91	24½	2,000
Springfield, Ill.	Moonlight	110	38½	2 000
Troy, N. Y.	All night	279	39½	2,000
Wichita, Kan.	All night	90	30	2,000

"From this table we learn the astonishing fact that the smaller cities and towns using fewer lights are supplied at cheaper rates than cities with many lights. If this is financially sound then electric lighting is an exception to all other business—for increased production usually means decreased cost (except electric lighting in Kansas City). It is not pleasant to notice that Kansas City, even at these high figures, heads the list by 2 cents per light, except the single city of San Francisco, which obtains coal from all over the world.

"We now present a list of cities that own their own electric light plants, and it can readily be seen by comparing this with the previous schedule that sound economy demands the council should secure a plant for this city at once.

"Cities supplying their own electric light:

Name of City.	Number of Lamps.	Candle Power.	Cost of each light per night.
Bay City, Mich.	134	2,000	16⅔
Bloomington, Ill.	220	2,000	20
Chicago	520	2,000	19
Hannibal	96	2,000	14⅓
Lewiston, Me.	96	2,000	11⅔
Little Rock	110	2,000	13⅓
Madison, Ind.	85	2 000	13½
St. Joseph, Mo.	208	2,000	14⅓
Topeka	184	2,000	18

"With reference to the three methods of lighting we would say that there is no office or place in this city where the subject of lighting is under control. It is no one's business to know whether the lamps and lights paid for are in position, or whether they are lighted and cleaned, so that we not only pay higher figures than any other city in the country for our light, but we do not even know whether the goods are delivered Besides, to properly govern this branch of public affairs some one should have an intelligent knowledge of it.

"We therefore recommend that in the construction of the new city hall an electric light plant be laid in the basement sufficient in power to light with electricity the whole building and the streets and alleys of the business part of the city; that the board of public works be instructed to make new contracts with regard to all three methods of lighting and report the same; that the lighting of the city be at once put under the board of public works, as per charter; that all accounts for lighting be credited by said board."

The lighting of the new Coates house is to be by electricity throughout, and the plant will be one of the largest isolated plants in the city. There are four Edison dynamos, two of 800 lights capacity and two of 300 lights capacity. The new switch-board will be so arranged that in case anything happens to the Coates house plant connection can be made with the central station of the Edison company. The Coates property is all lighted by central station power now, and the wires will not be taken out but retained in ready connection with the switch board. In all the hotel is to be lighted by 1,600 incandescent bulbs, the opera house by 500 and the remaining 100 distributed throughout the two Coates homesteads. William T. Osborne, the electrician of the house, has superintended the distribution of the wires. The question as to whether the wires connecting with the opera house and homesteads shall be laid underground or over poles is now being considered. Mr. Osborne says that it is more than likely the connections will be made by means of small iron poles neatly painted.

A matter of great importance to Kansas City, Kan., just now is the early completion of the West Side electric line. All along the projected route the people are unanimous in their approval of the scheme, and it is understood will bring such pressure to bear upon the council as to insure the immediate passage of the amended franchise. The company has not decided upon the system to be used but it is understood that the conduit system will be selected, and thus the company will be saved trouble in the future should the council compel underground electrical service. The storage battery system is also being investigated by the company.

The North East Street Railway company is using one of the Metropolitan Street Railway company's trail cars as an experiment before purchasing any for its own line. They work successfully and the North East company will place an order for several of them. This company is about to begin the construction of a new car barn at Burge park, the eastern terminus of its line. The present car barn is located on Lexington avenue, near Prospect avenue, and is also the power house. With the new cars to be added to the line the house now in use will not be large enough. The new barn will be 75x150 feet in dimensions, and will be built either of brick or corrugated iron. The present barn will then be used entirely as a power house. P.

St. Joseph, Mo.

St. Joseph, June 14.—W. M. Yenowine, superintendent of the Missouri & Kansas Telephone company, died at the Ensworth hospital in this city shortly after noon June 7. For some time he had been suffering from a tumor at the base of the brain, and for a month no hope of his recovery had been entertained by his relatives.

Mr. Yenowine was thirty-two years old, and was born in Keokuk, Ia. He was a practical electrician and five years ago was appointed manager of the St. Joseph Telephone exchange, and last year was made superintendent. In 1887 Mr. Yenowine organized the District Messenger Service company and was its president at the time of his death. He was also president of the St. Joseph Electrical Supply company, having organized that concern in 1889. In 1882 Mr. Yenowine married in Carthage, Mo., Miss Mary Easton. H.

Des Moines, Ia.

Des Moines, June 14.—The Edison company has just moved into its new building. It has one of the finest plants in the country. The building is located on the bank of the Des Moines river in the heart of the city, and every piece of machinery on the circuit is of the latest and best pattern. The wiring of the streets is all new, and the old poles and wires have been abandoned.

The city of Des Moines now uses but few electric lights, as the company which operates the arc lights has the contract for the gas supply, but the board of public works will soon advertise for bids and a change may be the consequence.

The improvements on the Des Moines electric railway continue. Two new dynamos have just been put in place and another 150-horse power engine has been ordered. The company has just taken out a permit for a permanent home for the machinery, to be built on a large tract of land where machine shops as well as a power plant can be located. A good building will be built, and will be well equipped. New cars are being added constantly and the extension of the lines goes on. The pay roll of the company last month was over $10,000, and the end has not yet been reached.

The use of the electric light in the smaller cities of Iowa is becoming quite as general as in the larger cities Places with a population of from 2,000 to 5,000 find the electric light a good thing and cheaper than gas would cost them. In Winterset, 2,200 people, the town built its own light plant and has had it in operation about a year. The city is lighted with 9 arc lights and 66 32-candle incandescents, and the people are well pleased with the result. The commercial rates are for 16-candle power light, 80 cents down to 30 cents per month. The income of the business will pay expenses and put probably $2,000 a year into the sinking fund. Pella, 2 000 people, has its streets lighted with 36 32-candle incandescents on contract from a company. Oskaloosa, with 3,000 people, has a half dozen arc lights and 50 incandescents. The company is paid about $1,000 a year for the service. Fort Dodge, with 5,000 people, has 20 arc lights and a number of incandescents on the streets. The city of Grinnell, with 2,500 people, is lighted with 20 arc lamps, and more will be added. Marshalltown, with 8,000 people, has a plant of its own and uses from 60 to 80 arc lights in the streets. Newton, 2,000 people, has been lighted with a dozen arc lights on contract, but many of the citizens want the city to build its own plant. Knoxville, 1,500 people, uses about a dozen arc lights. In Chariton the 1,500 people are content with about a dozen arc lights. These are by no means all of the cities that are using electricity for lighting. Clarinda, Creston, Missouri Valley, Jefferson, Waterloo and others are securing the lights. Osceola, a city of 3,000, is in a peculiar fix. The city council granted to a company in which nearly all of the aldermen were interested a twenty-year exclusive franchise for electric lights, and made a contract which would bind the city to pay them about $2,000 a year for lights. The citizens did not like it and held an indignation meeting which broke up the schemers. A movement is under way to have the city build its own station. Every Iowa city that has built its own plant has been well pleased.

Electric street railways in Iowa are rapidly driving out horse cars in other cities as well as Des Moines The first electric cars were at Davenport, and then Des Moines followed suit. The most successful of the electric lines is the one at Council Bluffs, crossing the river. Dubuque has an electric railway franchise and will soon have the cars, and at Keokuk Des Moines capitalists are rapidly transforming the lines into electric roads. Ottumwa is now using the electric cars and Sioux City has them in prospect. Burlington and Cedar Rapids are large cities yet without them. There are other good points in Iowa where electric cars might pay, such as Oskaloosa, Waterloo, Boone. Fort Dodge and Creston.

There was a commendable movement in Des Moines toward the formation of an electric club but it never materialized. There are a half dozen electricians in the city devoting their whole time to the subject, and now many of the employes of the companies are becoming well informed on electricity, so that next fall a good club can be formed which will be of great advantage to all. O. W.

Louisville, Ky.

Louisville, Ky., June 14, 1890.—The street railway deal by which the entire consolidated lines of this city pass to an Eastern syndicate was completed last week. E. E. Denniston, the Philadelphia banker who was here representing E. W. Clark & Co., bankers of that city, said that the First National Bank and the Fidelity Insurance Trust & Safety Deposit company, both of Philadelphia, were interested. The deal involves $4,000,000. Mr. Denniston says that $1,000,000 will be expended in gradually substituting electric motors on the entire system. The price paid was $1.90 for Louisville City Railway company's stock and $2.72 for Central Passenger Railway company's stock, the two companies owning the consolidated lines. Others interested are J. & W. Seligman & Co., Kidder, Peabody & Co., and Brown Bros. & Co., all New York bankers. Louisville people will be given a chance to go into the company, however.

One-half the lines will be equipped with electric motors by fall. One hundred motors have already been ordered of the Thomson-Houston company, and one has reached the city. The cars will be 16 feet in length and will draw four trail cars. Mr. Denniston said it would take considerably over 200 cars to make the service what it should be and the rest will be secured as soon as possible. The local management will not be changed. In order to allow fully for accidents there will be three power houses. One will be in the East End, one in the West End, and one South. Large real estate holdings of the company will thus be utilized. The 2,500 mules of the companies will be thrown out of employment.

The United States Signal Clock company, Gen. John B. Castleman, president, Theodore Harris, secretary, and S. L. Ewing, treasurer, last week made an assignment. The patent rights franchises will be sold. The assignment was made to the Louisville Trust company.

A model of a World's Fair structure has been forwarded to Chicago from Jacksonville. It contemplates a pyramidal structure 1,200 feet at the base and 1,200 feet high, with electric railways winding around the building from top to bottom. The proposed structure is to be of steel, glass and iron.

There is still a great deal of talk about the gas company's electric plant. Mayor Lyons says that within the next six months, unless there is delay in getting in its plant, the whole central portion of the city from Preston street to Seventh will be lighted by electricity.

Last Saturday night at Lexington, Ky., a large force of hands went to work on the construction for the electric railway on Main street and Broadway. The reason for the rush by night was that St. Louis and New York capitalists, minority stockholders, did not favor an electric line, and were expected to get out an injunction.

The entire street railway system of Savannah, Ga., it is said, has just been purchased by Nashville people, who found the substitution of electricity for mules in that city paid well. The parties interested are Messrs. I. T. Rhea, B. S. Rhea, Thomas W. Wrenne and J. H. Fall, and they will equip the Savannah lines with electricity at once.

The Louisville Gas company has secured a controlling

nterest in the Louisville Electric Light company. At the Directory election, Wednesday, the complexion of the Board was almost entirely changed, five of the seven directors being chosen from members of the Gas company. The Gas company will guarantee the bonds of the Electric Light company and all the stockholders who have not sold out will be given a chance to do so at the price paid the others.

The Light company's plant on Third street will be removed to Sixth and Green streets, as it is now on leased ground, and it will form a part of the Gas company's plant to be established there at once, but eventually the light plant will be removed to the river front where water and coal can be obtained cheaply.

The Brush Electric Light company is the only one remaining, but it has not yet sold out. However, there is talk of it, though President Muldoon says the Gas company has not even made an offer yet. He says the Brush company will sell for $65,000. The Gas company did not care to go into the electric light business but did so, President Morris said, because the field was enlarging. The Gas company, of course, gets the good will and all franchises of the Louisville Electric Light company, which is capitalized at $90,000. L.

Milwaukee, Wis.

MILWAUKEE, June 14. — The whole interest of S. S. Badger of Chicago in the Badger Electric Light company of this city has passed into the hands of John A. Hinsey. The announcement of the sale, which has been confirmed by Mr. Hinsey himself, caused a great deal of surprise. The Badger is the pioneer electric light company of Milwaukee. It had great difficulty, some five or six years ago, in getting a charter and might not have succeeded in the end had it not been for Hinsey. The latter was at that time, as he has been since until quite recently, one of the aldermen—president of the common council much of the time in fact. He did yeoman service for the Badger concern and has always stood up for it through thick and thin. For some time the gossips have had it that Hinsey had a large block of stock in the corporation. Be that as it may, Badger and Hinsey were interested together in other business enterprises, and the surprise caused by the recent deal was not due to Hinsey engaging in the electric light business, but to the fact that Badger had transferred all his interest to Hinsey. Being now at the head of an electric light company, as well as an electric street railway, it is supposed that Hinsey will soon give up his position as special agent of the St. Paul railroad. On the other hand, however, a movement is on foot to bond the city so as to allow it to purchase the Badger plant, and it may be that Hinsey considers that his ownership of the system will be as short as it promises to be profitable.

Hinsey denies a report that he failed to secure control of the Whitefish Bay Dummy Line. He reiterates his intention of beginning work on the east side and south side branches of his electric railway.

Henry Villard has acquired quite a large interest in the Milwaukee City railroad, and that line, which is the largest in the city, will be equipped with the Sprague system Henry C. Payne, the vice-president of the Milwaukee City railroad, who has just arrived home from New York, states that about $1,000,000 will be expended in converting the road into an electric line. The road will be entirely rebuilt and Mr. Payne states that when the work is completed the line will be second to none in the country. It is expected that seventy-five motor cars, with trailers, will be in operation on the line about January 1.

During the absence of Mr. Payne, it was reported that the Milwaukee City and Cream City systems were to be consolidated, but Mr. Payne pronounces the story untrue. However, Messrs. Sproul and Kennedy of the Cream City Street railway, have been in New York for some time and it is understood that they have been trying to induce Villard to take an interest in their road and convert it into an electric system, on the same conditions that govern the deal between Villard and the Milwaukee City Railroad company.

Electric Road for Baltimore.

The Baltimore (Md.) Traction company has applied to the city council for a franchise to use electricity for street car propulsion. This company has for some time been building cable lines and the application for the franchise for an electric line aroused considerable interest. It now appears that two representatives of the company recently purchased for the company the line of the Baltimore, Pimlico & Pikesville railway, seven miles long, and it was decided to substitute electricity at once upon it. The Maryland Agricultural association grounds are on this line about half way out, and this fact alone shows that the cable company has implicit confidence in electricity, else it would not introduce it on such an important line.

THE ELECTRIC LIGHT.

Apalachicola, Fla., contemplates installing an electric light plant.

An electric light plant will be put in Trinity College, Durham, N. C.

The Tampa (Fla.) Bay Hotel will have a 2,000 incandescent lamp plant.

The Athens (Ga.) Electric Light company is contemplating enlarging its plant.

The Richmond (Ky.) Light & Water Works will put in an electric plant as soon as arrangements can be perfected.

The Vanderbilt Steel & Iron company will light its works at Birmingham, Ala., with electricity, and may operate its machinery by motors.

Residents of Cleburne, Texas, have formed an electric light company and also made a contract with the Westinghouse Electric company for one of its 500-light alternating current machines.

It is stated that G. H. Van Etten, representing a Canadian syndicate, has purchased the plant of the Edison Electric Light company at Little Rock, Ark., for $65,000, and will make extensive improvements.

Articles of incorporation were filed last week by the Grand Forks Water, Light & Power company of Grand Forks, Minn., to construct electric light and power plants at that place. The capital stock is $100,000, and the incorporators are L. P. Ordway, Charles S. Rogers, John M. Gillman, James A. Haight, N. M. Thyson, all of St. Paul.

The Royal Electric company of Montreal, which handles the Thomson-Houston company's apparatus, has closed several large orders of late. It will install a 200-light incandescent plant in the popular summer resort Vaudreuil. The governors of Notre Dame hospital have made a move in the right direction by adopting electricity for the lighting of the hospital throughout, says the Montreal *Gazette*. As a sanitary measure, superior light and more comfort for the patients, it will be a great improvement over their present system of illumination.

The municipal assembly of Karlsbad has decided to construct an electric lighting station and has placed an order for a plant of 5,000 lights' capacity. The alternating system will be used and in a short time one of the most popular watering places in Bohemia will be illuminated by electricity and will moreover own the plant. As a reason for the installation of the works, it is stated in the report of the council that Karlsbad, as a world-famed watering place, could not remain behind towns which have already introduced the electric light.

A Seattle, Wash., paper says T. H. Tyndale has arrived from Portland with the books of the Seattle Electric Light company and instructions from Henry Villard directing him to reorganize the company, placing the capital stock at $500,000. Mr. Tyndale conferred with the officers of the company, and the following were named as the trustees of the new company: T. H. Tyndale, James A. McWilliams, John A. McWilliams, J. M. Frink and J. H. McGraw. Another meeting will be held in a few days, when the officers of the new company will be elected. The reorganized company will improve and largely increase the present electric plant, will add all kinds of electric power and machinery used by the Edison companies, and will place all wires underground. The changes and improvements will be made as soon as plans can be prepared.

THE ELECTRIC MOTOR.

Bountiful, Utah, is so have an electric line railway. The line will be known as the Salt Lake & Bountiful railroad, and will begin at the Warm Springs, running via the Hot Springs to Bountiful, a distance of eight miles. The Salt Lake street car line is already at the Warm Springs, and the Bountiful line being made the same gauge can have its cars brought into the city on its tracks or an exchange of passengers made.

Recent New York dispatches concerning Chicago securities report an unprecedented boom. One of these financial reports says: "The feature, however, among the specialties was Pullman's Palace Car stock, which is up 6½. The rise was coincident with talk about enormous earnings from the World's Fair, of an expected decision in an important land suit, and of a new stock issue in connection with the Westinghouse-Pullman electric car plant in Pittsburg."

The work on the electrical equipment of the Utica & Mohawk Electric railway at Utica, N. Y., is being prosecuted as rapidly as possible, and it will not be long before the cars will be ready for operation. The motors and line equipment have already been shipped, and the final shipment of station equipment it is expected will be made in a few days. Each car will be equipped with two 15-horse power Sprague improved electric motors with all the latest improvements.

Prof. Elihu Thomson, on being questioned regarding the feasibility of substituting electric power for cable power for the propulsion of cars on the Brooklyn Bridge, said that there would be no particular difficulty in superposing on the bridge an electric system, if desired, or replacing the cable system by an electric system. Prof. Thomson, however, added that he has always been of the opinion that the Brooklyn Bridge presented conditions specially favorable for the working of the cable system, yet the people who depend upon this system are anything but satisfied with the service.

A press dispatch from Milwaukee says: "The consolidation of the Milwaukee City and Cream City railways has been effected. Both roads are owned by Eastern syndicates, and the deal is said to have been consummated in the East. It is reported that the Hinsey electric line is also included in the consolidation, but this was denied by Mr. Hinsey on his return from the East Both the Cream City and Milwaukee City lines will now be transformed into an electric system. The National Home and North Greenfield railroad company and the Milwaukee and Wauwatosa Motor line are about to pool issues and operate both systems under one management. The new deal contemplates the building of eleven miles of extra main and spur tracks at an additional cost, including equipment, of about $250,000."

The people of Salt Lake City have begun to realize the benefits to be derived from the electric motor for street railway service, and they are now eager to utilize it in every possible case. Negotiations are pending for an extension of the service to Liberty Park. With the object of supplying this service to the people of that neighborhood the Salt Lake Rapid Transit company has laid its track down State road to Seventh South street; thence east to Ninth East and thence again south on Ninth East to the intersection with the Utah Central track running to Park City. The Rapid Transit company is now continuing its line from the last-named point to the center of Forest Dale. The contract provides that the track shall be completed within the next ninety days, and that electric cars shall be run to Forest Dale as soon as the necessary electrical equipments can be furnished for any part of the company's system; time not to exceed six months.

A St. Louis paper says Charles Sutter insists that if the municipal assembly will give the Dorsett conduit, in which he is interested, a fair chance and no favor, the subway company will complete its work within a year. By a "fair chance" he means that the Bell telephone and St. Louis conduits, for which bills are now pending in the assembly, be saddled with the same restrictions and obligations as those already imposed upon the subway company. The Dorsett conduit, as far as completed, comprises Chestnut from Fourteenth to Tenth streets, south to Market, east to Broadway and north to Christy avenue. The remainder of the work contemplated includes the levee from Franklin avenue to Spruce street. Mr. Sutter made a strong argument recently before the council committee on public improvements, in which he urged the iniquity of granting valuable franchises for conduits to the corporations now seeking them, without exacting the same conditions and compensation as were imposed upon the Dorsett enterprise. The committee still has the matter under consideration.

THE TELEPHONE.

The wires of the Bell Telephone were badly shaken and twisted by the hail at St. Louis last week. Six hundred and nine lines were down Thursday night. A number of the wires were either broken or knocked down, while others were twisted or torn from the poles in places and hung almost to the ground without being entirely torn down. A large corps of men were put to work repairing the wires.

A dispatch from New Haven, Conn., says: "A novel telephone has been placed in the New Haven house. It cannot be used unless a fee is paid. There are five slots in the machine for the reception of a nickel, ten-cent piece, quarter, half dollar and dollar, respectively. These amounts cover the rates charged for telephoning to various places in and out of the state. To use the telephone it is first necessary to call up the central, as on an ordinary telephones. The objective point is then asked for, and when this if reached the party who rings up is told to put the necessary fee in the slot. If a dime is dropped in a bell of high tone rings. For twenty-five cents the tone becomes lower, and for half a dollar the sound is like that of the average doorbell. The dollar sound is similar to that of a fire-alarm gong. The sound of the bell is the signal to go ahead and talk. The contrivance is the invention of William Gray of Hartford. A company has been formed for the manufacture of the instruments."

Miscellaneous Notes.

Electrical engineering is assuming its proper position in the University of Pennsylvania, and the course in that department next year will be most complete in all respects.

The *Inter-Mountain Mining Review* is the name of a weekly journal which made its first appearance at Salt Lake City last week. It announces that it will give considerable attention to electrical machinery which is becoming such a prominent factor in mining. The *Review* is a bright, newsy sheet, and promises well.

Salt Lake City is fast coming to the front as a consumer and user of electricity as a useful and potent agent of industrial progress, says a local contemporary. A telephone system embraces the city proper and all the surrounding towns, mining camps, mills and smelters, with a list of more than 1,800 patrons. Telegraph lines lead in all directions from the city and are well and liberally patronized. One of the finest street railroad systems in the country is in operation, the motive power being electricity. Another electric line is under course of construction and will be in operation in a short time. An electric light company supplies the city, as well as the public business houses, public buildings, and all residences, whose owners prefer it, with light of excellent quality.

Personal Mention.

James C. Hobart, of Cincinnati, and Miss Lucretia Winchell were married June 4 in the New Jerusalem church, Cincinnati. Mr. Hobart is connected with the Triumph Compound Engine company of Cincinnati.

Business Mention.

The Central Electric company of Chicago, last week, sold a customer 100 miles of improved Candee weather-proof wire.

Eugene Munsell & Co. of New York report unusually

large sales of mica in consequence of the proposed increase in the tariff.

The C & C. Electric Motor company has just issued a handsome pamphlet descriptive of the motor work in church organ blowing.

The John Stevenson & Co. celebrated cars are becoming a feature in electric railway service and the factory is taxed to its fullest capacity to keep up with the orders.

The Bishop Gutta Percha company of New York recently received an order from Chicago for thirty miles of cable to be made and delivered in thirty days. Pretty quick work!

The Electrical Safety company of Boston announces that the Cartwright protector for electrical instruments, which it handles was recently tested by the Boston fire underwriters' board and approved This company also owns and controls other devices for protecting electrical instruments and circuits.

The Standard Electric company of Vermont (Boston) announces that it has had an unusually prosperous season and furnishes a list of plants installed by it aggregating 10,150 lamps capacity The company's work has been confined heretofore to the eastern states, but it is now ready to fill orders in any part of the country.

General Agent W. E. Sheldon, of the Schuyler Electric company, reports the following recent sales and installations: Blacksburg, S. C., 30 arc lights, to be running July 1; Buena Vista, Va., 50 arc lights and 500 incandescent. This plant was started up last Saturday night. The Polo, Ill., plant, with 30 arc lights, was started this week.

Geo. B. Prescott, general agent for A. G. Day of New York has just issued a neat new price list of kerite insulated wires and cables. The little book contains a number of cuts descriptive of the various cables and also a set of new tables relating to copper and iron wires. On the back of the list is an interesting half tone view of the Day factory at Seymour, Conn.

The Electrical Merchandise company have recently rented the large store at 11 Adams street, Chicago, and are busy putting these premises in shape for the conduct of their business. They are sole agents for the sale of the lattice iron poles of the Wisconsin Bridge & Iron company. These poles are in use by a large number of the leading electrical railways in the country.

The Central Electric company of Chicago has just completed arrangements with the Butler Hard Rubber company to handle the latter company's product in hard rubber. Samples of this new material are exhibited showing that it can be easily turned, and takes a beautiful finish. This rubber is made in the usual forms of sheet, rod and tube, and a large demand is predicted for it.

The Page Belting company of Concord, N. H., manufacturers of leather belting, both staple grades and specialties, have recently received orders from the following among many parties, from whom orders have come for the Acme link belt: Alexander Bros., Philadelphia, Pa.; Gardner, Cook & Son, Laconia, N. H.; Dansville Electric Light company, Dansville, N. Y.; Orr & Co., Troy, N. Y. (second order). Orders for three belts were received from Richmond, Va., and orders from the Empire Mills company, New York; R. Dudgeon, New York; R. Hoe, New York; Lackawanna Iron & Coal company, Scranton, Pa. (second order) were taken.

Since taking the western agency for the Burnley dry battery, the sales of the Central Electric company have reached up in the thousands. This battery is being extensively used by companies and individuals who have been looking for a dry battery of merit. The enormous demand for okonite remains unabated. Larger stocks than ever are carried of all kinds of electrical specialties, and the company seems crowded for room. The open-handed patronage the Central Electric company receives from all parts of the country, and the good feeling existing with its customers, is evidence of the personal popularity of the officers of the company, as well as the high standing of goods it turns out.

The Massachusetts Electrical Engineering company of Boston has issued a circular explaining the work it engages in. Its consulting engineers include: W. W. Jacques, Ph. D., electrician, American Bell Telephone company; S. W. Holman, S. B., professor of physics, Massachusetts Institute Technology; Edward Sawyer, C. E., mill and hydraulic engineer; Geo. W. Blodgett, S. B., electrical engineer, Boston & Albany R. R.; Arthur L. Plimpton, S. B., engineer, West End Street Railway company. With this excellent staff the company is prepared to furnish disinterested advice and information upon all electrical matters. Other special lines: Electric light and power plants designed, estimates obtained, and installation superintended; practical tests made upon all electrical apparatus as to economy, efficiency, adaptability to its proposed use, etc.; the validity of inventions examined and reported upon.

The Ball Engine company of Erie, Pa., have furnished engines for thirty-six different electric railways, aggregating 9,700-horse power. Among orders recently received are, Elgin Street Railway company, Elgin, Ill., two 150-horse power tandem compound; Johnstown Passenger Railway company, Johnstown, Pa., three 150-horse power engines; Winston Electric Railway company, Winston, N. C., two 150-horse power engines; Rockford Street Railway company, Rockford, Ill., one 150-horse power tandem compound; Binghamton Street Railway company, Binghamton, N. Y., one 10-ohorse power engine; South Side Land Improvement company, Richmond, Va., one 100-horse power engine; Rochester Street Railway company, Rochester, N. Y., three 300-horse power triple expansion engines; Rochester Street Railway company, Rochester, N. Y., three 150 horse power standard engines; Rochester Street Railway company, Rochester, N. Y., one 60-horse power standard engine; Belt Line Electric Railway company, Port Townsend, Wash., one 300-horse power double compound; Southern Railway company, St. Louis, Mo., five 150-horse power tandem compound engines.

The new store of the Great Western Supply company at 190 and 195 Fifth avenue, Chicago, is being rapidly filled with the large and complete stock of electrical goods of all kinds. Geo. Cutter has completed the employment of his leading assistants. Chas. G Armstrong, late connected with the Monitor Electric company, has charge of the house goods department, and a gentleman recently connected with a leading railway supply house, will have control of the department of street railway supplies, and the late representative of a prominent eastern house will have the management of the fixtures department. The company has received during the past week at its store a large quantity of wire, and one of the largest stocks of glassware for electric lighting purposes that has ever been brought to the West. Mr. Cutter feels much encouraged by the outlook, and states that orders are already coming in to the company in a most satisfactory way. The arrangement of the shelving and show cases of the first floor is practically completed, and the offices on the second floor, which are most conveniently arranged, will be ready for occupancy in a few days. The signs in the front of the building are very handsome, and the lettering on the windows is unique and attractive.

The Sperry Electric Mining Machine company has moved to offices in its factory, 205 S. Canal street, Chicago. A. L. Sweet has sold his interest in the company and resigned the presidency, his place and interest being taken by W. D. Ewart, who is president of the Link Belt Machinery company of Chicago. A. D. Dana, treasurer of the Link Belt, becomes treasurer of the Mining Machine company, and H. E. Goodman retains his office of secretary and manager, while Mr. Sperry still serves the company as electrical engineer. The company has twenty of its standard machines in process of construction. For these the Link Belt Machinery company furnishes the iron parts, the motors being added and the machines being put together at the factory of the company under the supervision of Mr. Sperry. Mr. Ewart, well known as the inventor of the link belt, will be especially valuable to the company as consulting engineer, and the increased manufacturing facilities will make it possible for the Mining Machine company to care for its increasing business. The plant of the ten machines furnished one shaft of the Chicago, Wilmington & Vermillion Coal company at Streator, Ill., is well known to be a working success, and the company is at the present time installing an electric pumping plant in the No. 3 shaft of the same company.

Electrical Patents.

Issued June 10, 1890.

429,596. Galvanic Battery. John Beattie, Jr., Fall River, Mass.

429,599. Electric Annunciator. James D. Bishop, Chicago, Ill.

The invention consists in inclosing each coil in a soft iron shell, with which shell is magnetically connected an armature which extends centrally through the coil and serves to operate the visual or other signal device.

429,608. Manufacture of Incandescent Electric Lamps. Richard N. Dyer, New York, N. Y.

429,687. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

429,703. Galvanic Battery. Jose Siliceo, Jr., Mexico, Mexico.

429,727. Lightning Arrester. Oliver J. Lodge, Liverpool, County of Lancaster, England.

429,729. Generator for Electrically Reciprocated Tools. Harry N. Marvin, Syracuse, N. Y.

429,730. Electric Drill System. Harry N. Marvin, Syracuse, N. Y.

Each drill has two oppositely acting coils included, respectively, in independent circuits, into which are delivered in alternation current impulses or alternations by a suitable generator or source of current.

429,731. Electric Drill System. Harry N. Marvin, Syracuse, N. Y.

Generally stated, the invention consists in a transformer adapted to convert direct or continuous currents of a given potential into pulsating currents of the same or another potential, which is to be connected at any desired point in an electric circuit, and which may be used to operate one or any desired number of reciprocating drills.

429,732. Generator for Electrically Reciprocated Tools. Harry N. Marvin, Syracuse, N. Y.

An object of this invention is to provide means for operating the drills at a lower rate of speed relatively to that of the generator than has heretofore been done.

429,735. Multiple Telegraphy. Francis J. Patten, New York, N. Y.

429,736. Dynamo Electric Machine. Richard Pfund, Brooklyn, N. Y.

The invention contemplates the direct conversion of the alternating currents generated in the armature of a machine through the agency of a converter or transformer whose primary coil is mounted upon and revolves with the armature shaft and is connected directly with the coil or coils of the armature, and whose secondary coil is stationary, thus permitting of the direct connection therewith of the wires of the consumption circuit.

429,737. Impression Device for Matrix Making Machines. Casper L. Redfield, Minneapolis, Minn.

429,745. Electric Connection. Charles J. Van Depoele, Lynn, Mass.

429,746. Electric Railway Motor Truck. Charles J. Van Depoele, Lynn, Mass.

429,747. Telpher System. Charles J. Van Depoele, Chicago, Ill.

429,751. Electric Meter John H. Barnard, Asheville, N. C.

Broadly considered, the invention consists in a meter containing a train of wheels impelled by a string or weight and operating a register and governed by a device operating on the principle of a pendulum, but in which the attractive force of an electric current or a magnet energized thereby is substituted for the attraction of gravitation.

429,787. Electric Arc Lamp. Carl Coerper, Ehrenfeld, Germany.

429,801. Telephone. William Vogel, Chicago, Ill.

429,815. Cable Terminal. John C. Reilly, Brooklyn, N. Y.

429,817. Electric Burglar Alarm. Harold C. Shubert, Chicago, Ill.

429,825. Electric Regulator. Edmund Wagemann, Little Rock, Ark.

429,887. Galvanometer. Arthur E. Colgate, New York, N. Y.

429,895. Galvanic Battery. George H. Felt, New York, N. Y.

429,896. Electrode for Galvanic Batteries. George H. Felt, New York, N. Y.

429,897. Porous Cell for Galvanic Batteries. George H. Felt, New York, N. Y.

429,898. Solution for Galvanic Batteries. George H. Felt, New York, N. Y.

429,899. Railway Signal System. Leroy B. Firman, Chicago, Ill.

429,912. Secondary Battery. Carl Hering, Philadelphia, Pa.

429,913. Secondary Battery. Carl Hering, Philadelphia, Pa.

429,914. Secondary Battery. Carl Hering, Philadelphia, Pa.

The accumulator consists of a pile of plates of active material, conducting sheets, and non-conducting sheets placed horizontally and serially superimposed and juxtaposed.

429,946. Machine for Turning Dynamo Commutators. Horace G. McLean, McPherson, Kan.

429,981. Electric Railway Conductor System. Charles J. Van Depoele, Lynn, Mass.

The invention comprises sectional working conductors connected at their ends to adjacent sections by an insulating support and electrically connected to each other by a fusible connection which spans the insulating support.

429,982. Mechanical Telegraph Instrument. Eugene R. Waterhouse, St. Louis, Mo.

430,010. Underground Electric Conduit. Henry Flad, St. Louis, Mo.

Of the eleven claims the ninth is appended:

"The combination, with man-holes and enveloping pipes connecting these man-holes, of a drip-pipe in the lower end of each section of enveloping pipe and a pipe for indicating the presence of water within the pipe."

430,025. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

430,054 Switch Board. Johan M. Anderseo, Boston, Mass.

430,058. Method of Separating Ores Magnetically. Clinton M. Ball, Troy, N. Y., and Sheldon Norton, Hokendauqua, Pa.

The process consists in mingling water with the mass, then subjecting the latter to the simultaneous action of magnetic attraction and centrifugal repulsion, while at the same time causing a current of air to impinge upon the separated iron or ore.

430,060. System of Electrical Distribution. Edward M. Bentley, Boston, Mass.

The invention consists, in general, of means whereby, upon the occurrence of any variation in the number of lamps in one group, the surplus current which is not used by the smaller group may be employed to assist the main generator.

Claim 2 reads as follows:

"The combination, with a multiple arc group of translating devices in series with a similar group, of an electric motor in circuit with one of the groups and connected with the main generator to assist in driving the same."

430,065. Key Board Self Playing Attachment. Joseph D. Case and Clark W. Evans, Plainfield, N. J.

430,066. Electric Piano Player. Joseph D. Case and Clark W. Evans, Plainfield, N. J.

430,075. Galvanic Battery. Charles A. Hitchcock, North East, Pa.

430,076. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

430,094. Tool for Truing Dynamo Commutators. Allen D. Spencer, Baltimore, Md.

430,096. Automatic Electric Cut-out. Montgomery Waddell, New York, N. Y.

11,083. Electric Railway. Walter H. Knight, Newton, Mass.

11,084. Electric Railway. Walter H. Knight, Newton, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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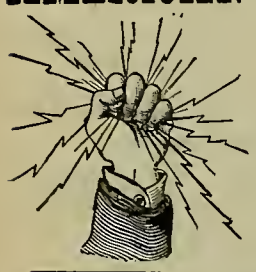

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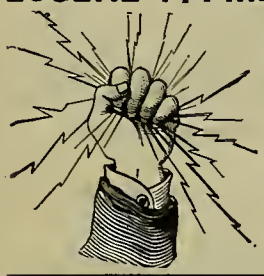

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FRANCIS W. PARKER,

Patent Lawyer and Solicitor.

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Sealed proposals will be received at this office until Tuesday, July 1, 1890, at 10:30 o'clock A. M., for furnishing, erecting and maintaining 100 or more electric lights of 2,000 nominal candle power, for lighting the streets of the city of Milwaukee for a term of three years, commencing December 15th, 1890.

Such lighting, wiring and all other work necessary thereto to be done under the regulation of such ordinances and resolutions as have been or may hereafter be passed by the common council of the city of Milwaukee.

All bids must specify the kind of light to be furnished, and must be accompanied by a good and satisfactory bond in the penal sum of $50,000.00, approved as to form and execution by the city attorney.

All bids received will be submitted to the common council for consideration.

All bids must be stated in writing and in figures.

Signed, G. H. BENZENBERG,
W. P. O'CONNOR,
GEO. P. TRAEUMER,
GARRETT DUNCK,
Commissioners of Public Works.

Countersigned May 20, 1890.

FRED F. WILDE,
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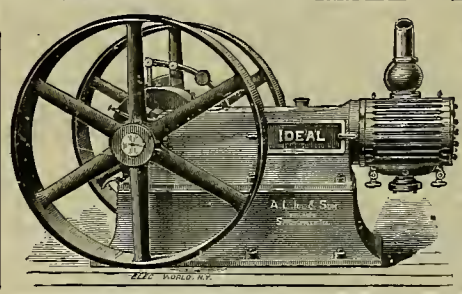

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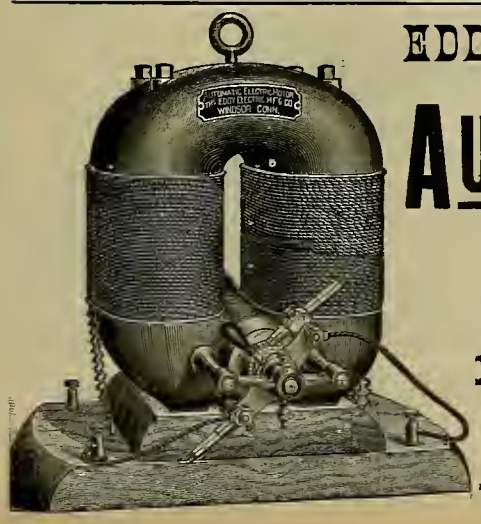

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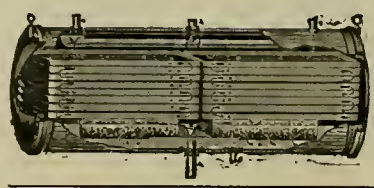

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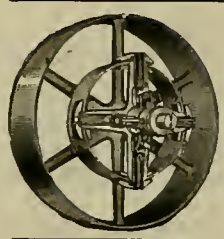

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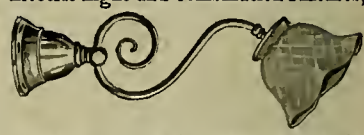

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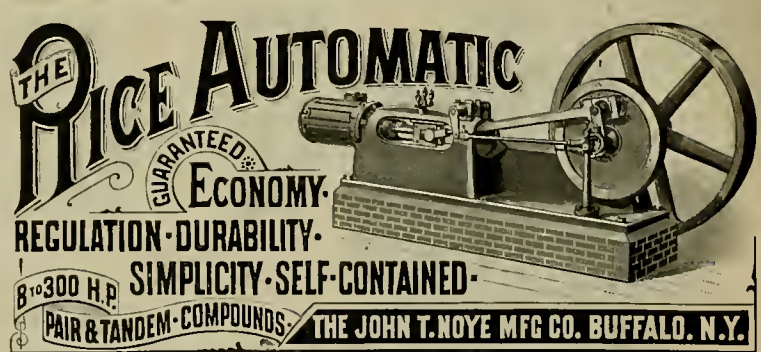

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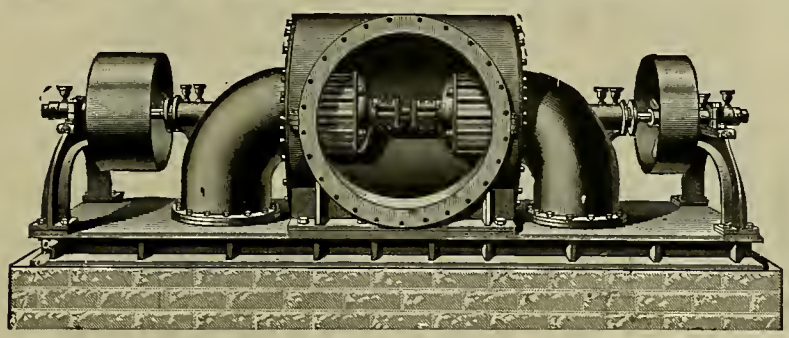

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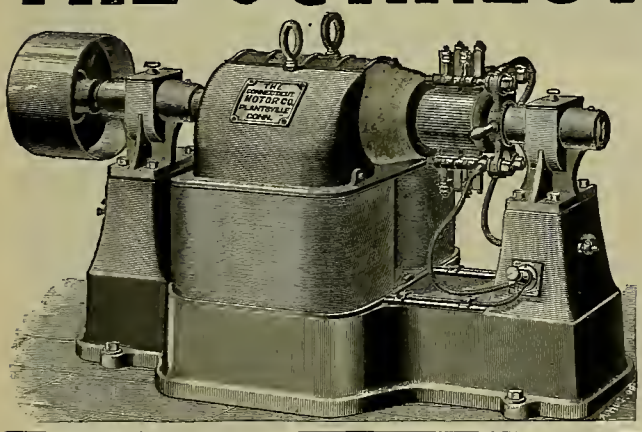

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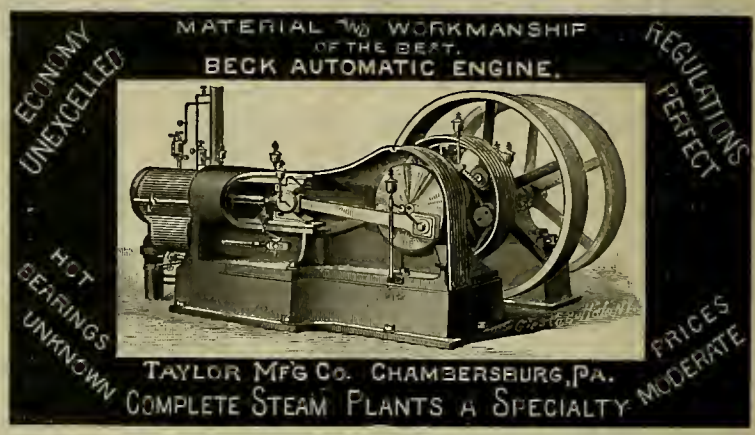

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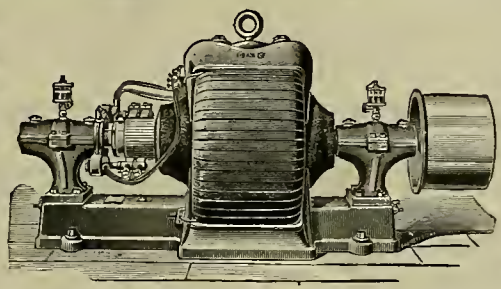

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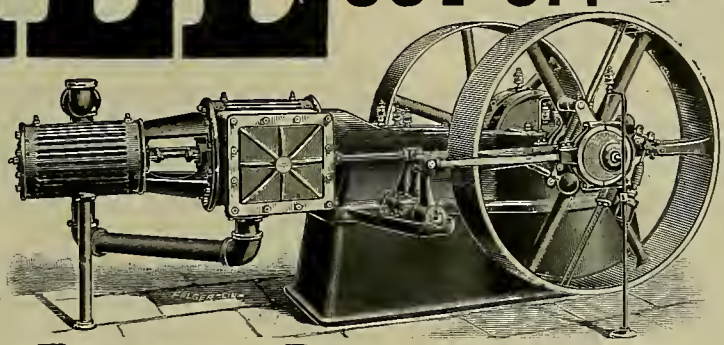

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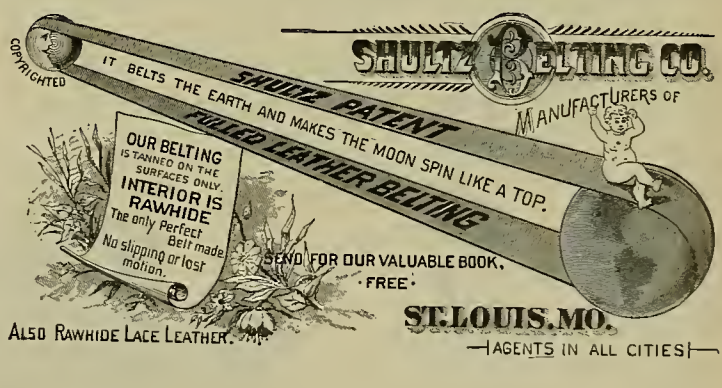

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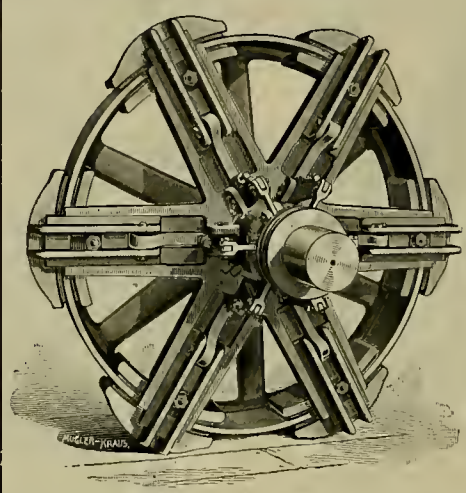

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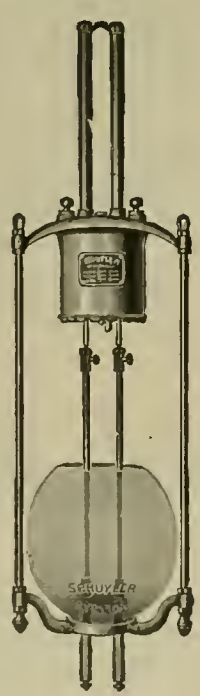

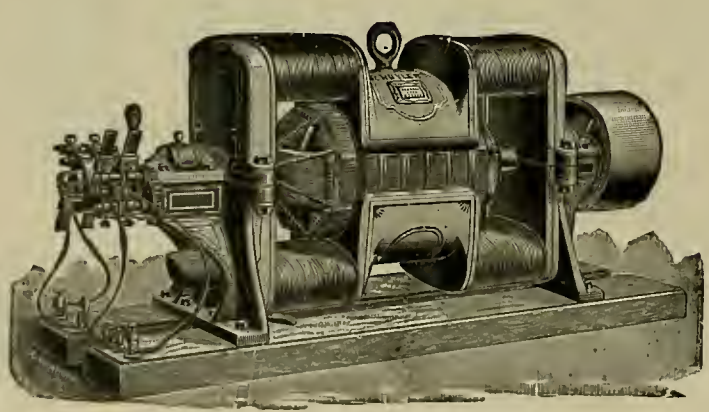

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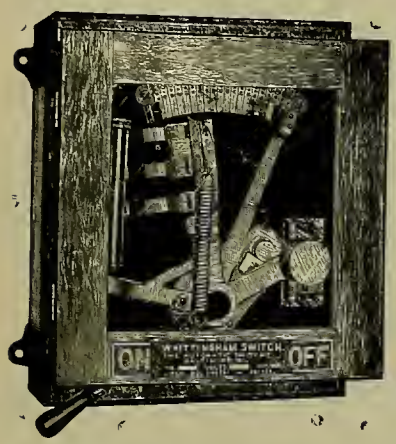

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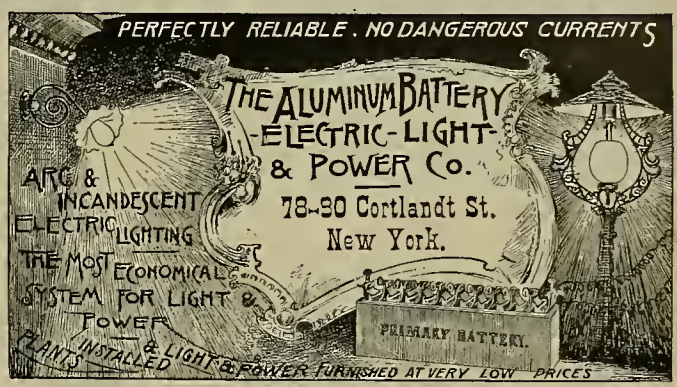

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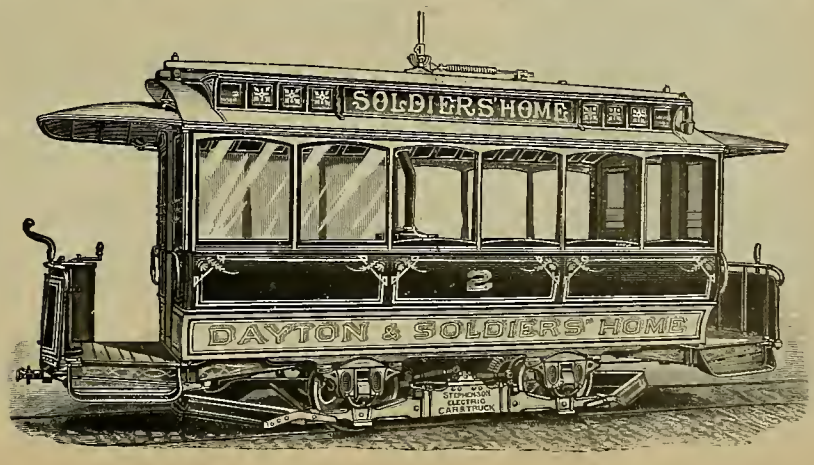

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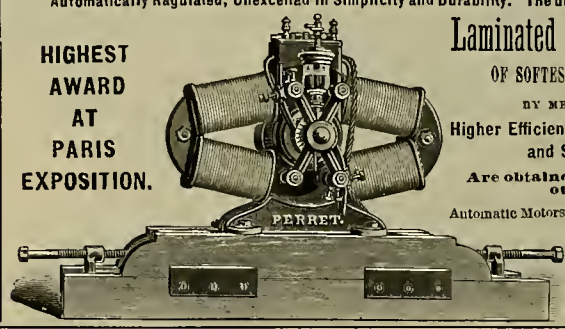

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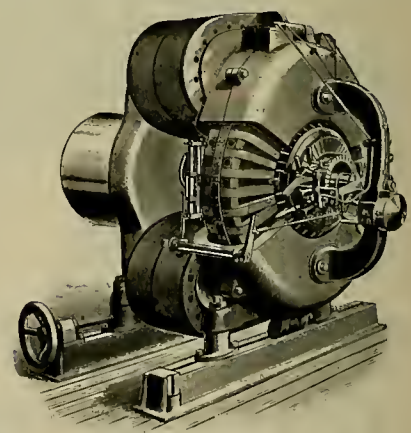

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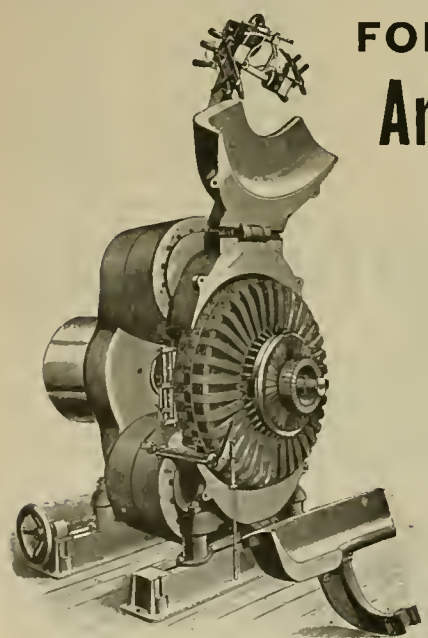

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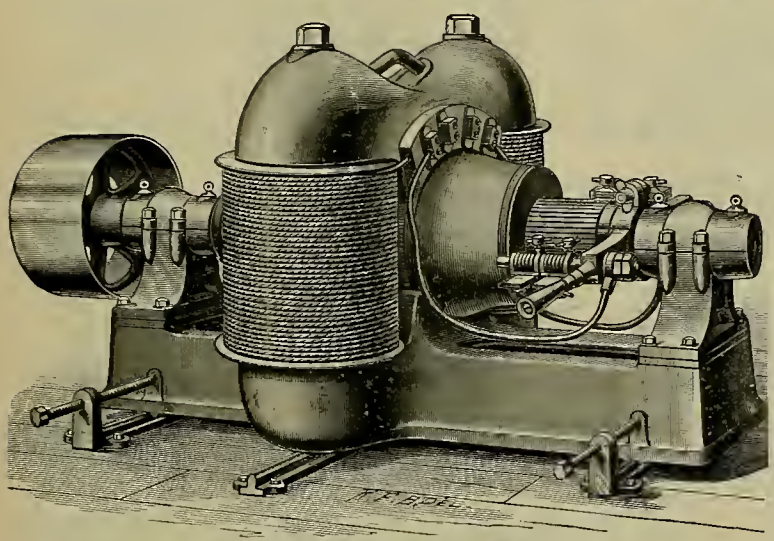

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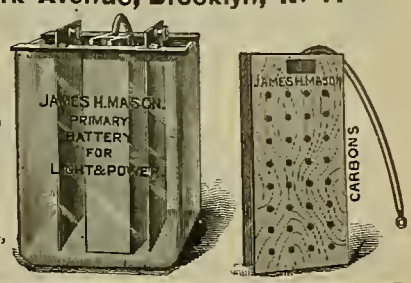

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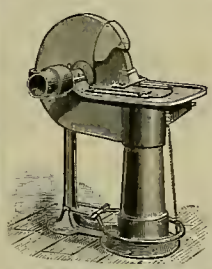

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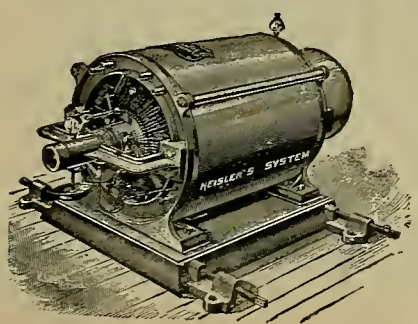

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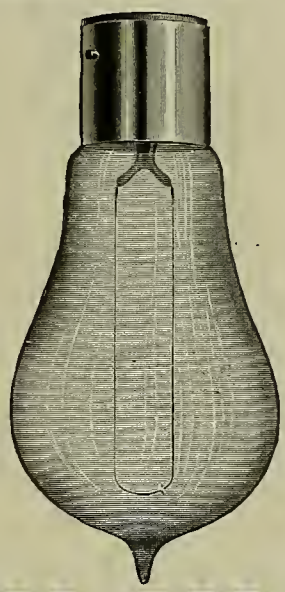

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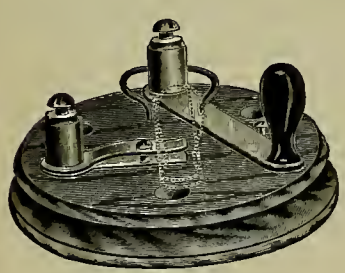

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DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:--

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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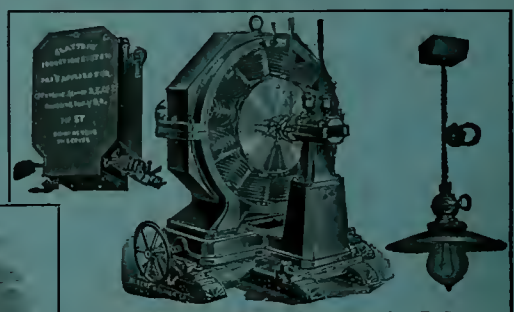

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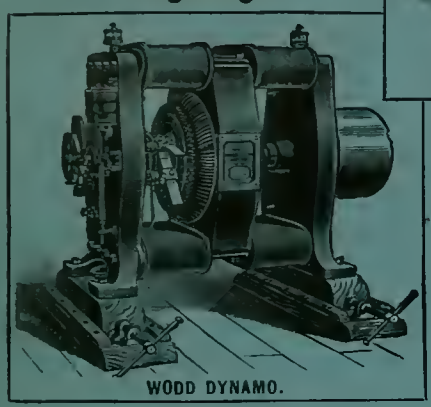

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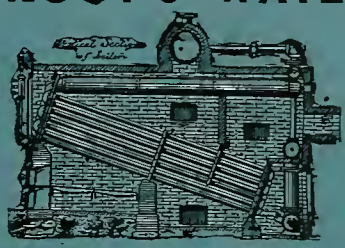

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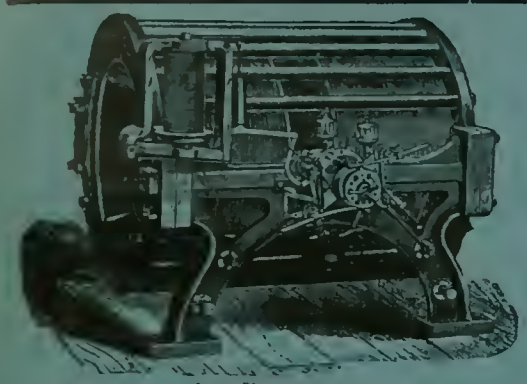

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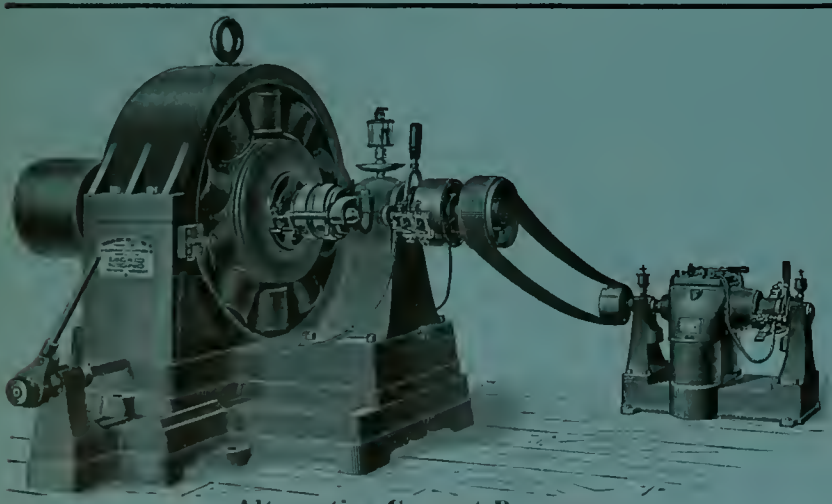

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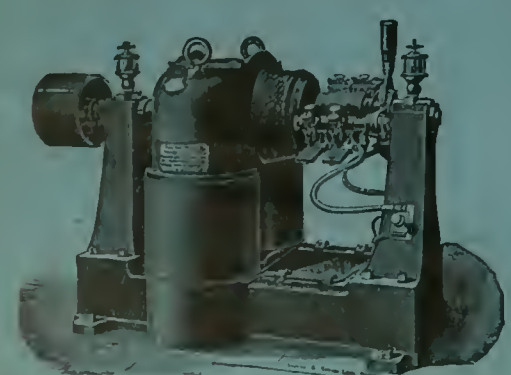

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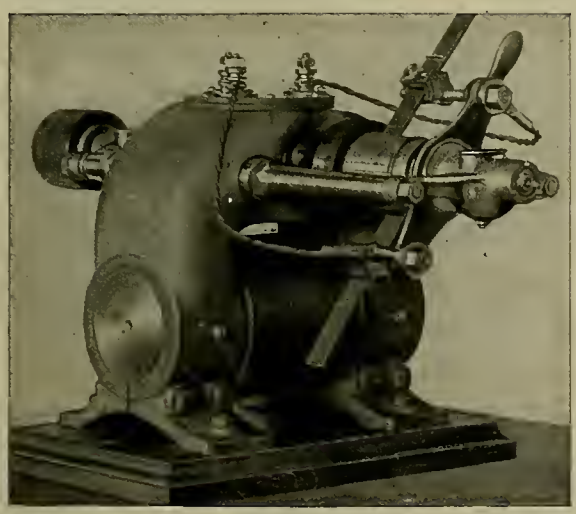

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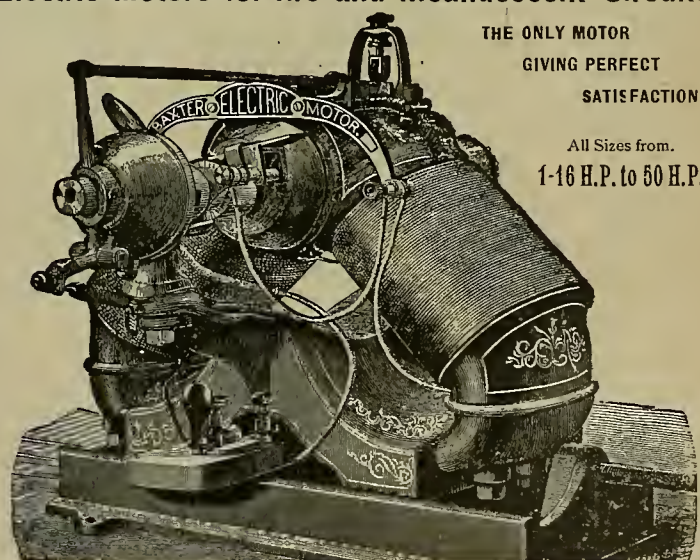

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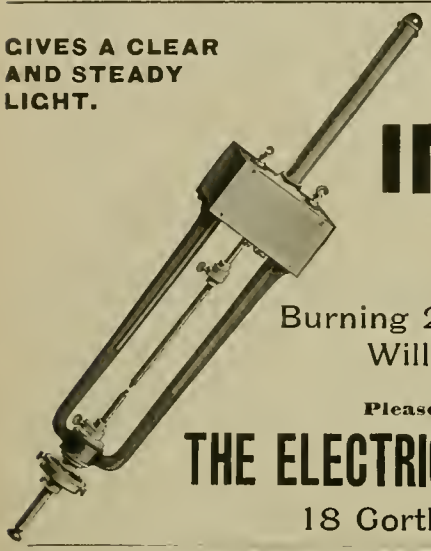

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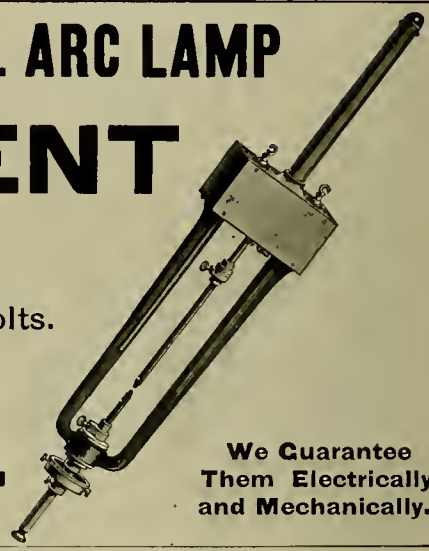

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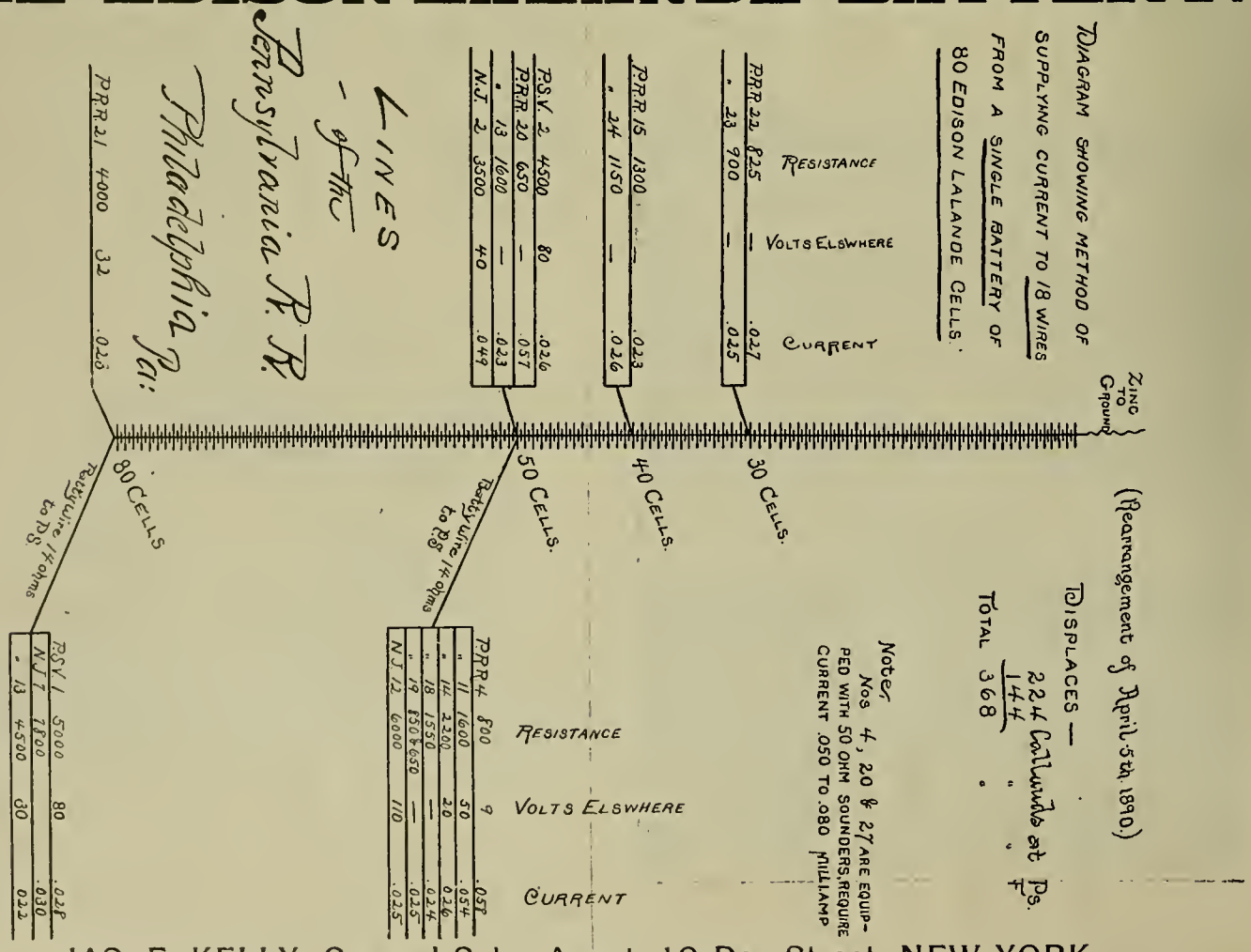

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The Crosby Dry Batteries are manufactured in different sizes and forms, to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

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GENTLEMEN:—The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan. 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29, when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan. 30; 7:30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing. Very respectfully,

(Signed) OTTO FLEMMING.

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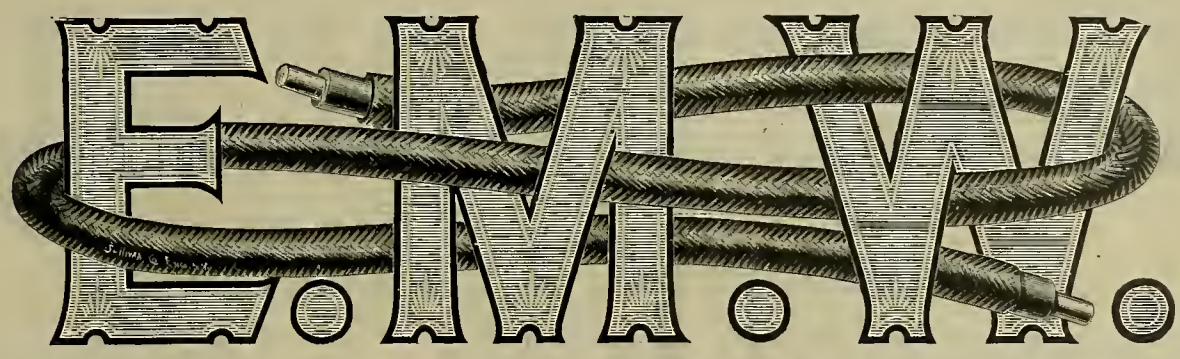

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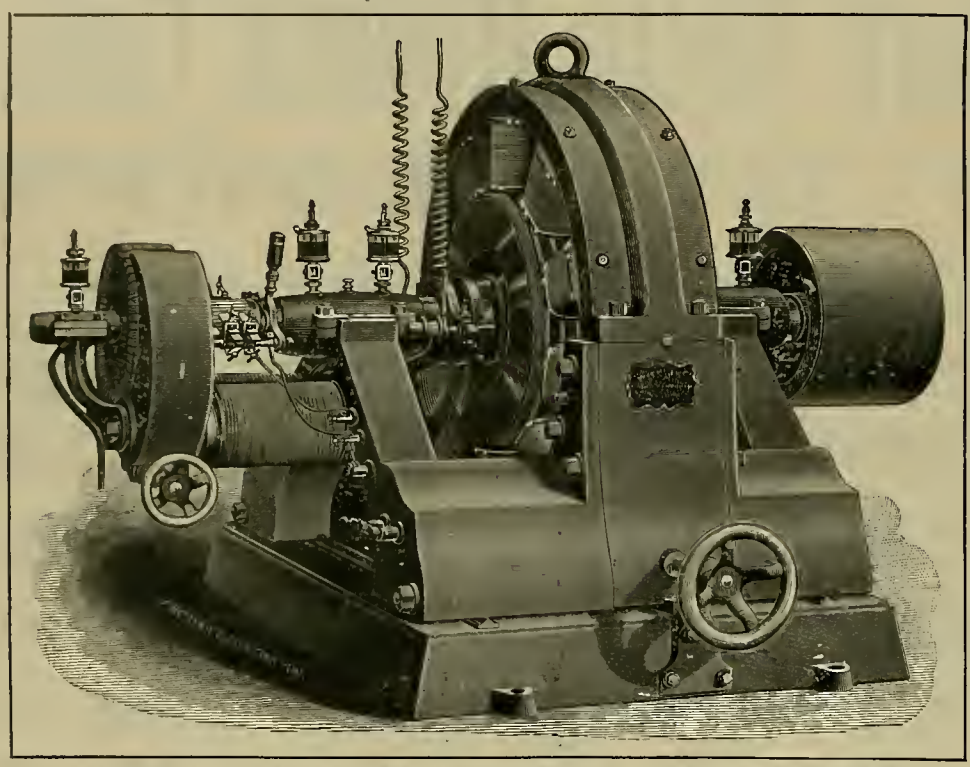

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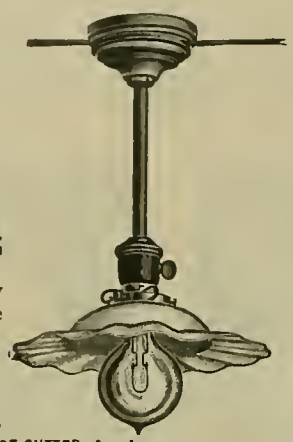

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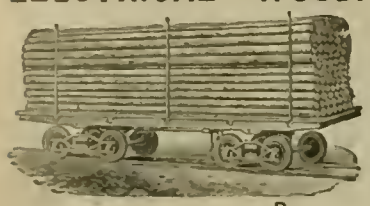

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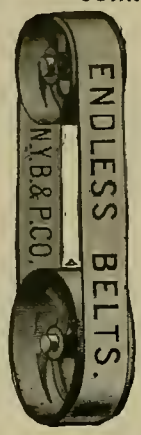

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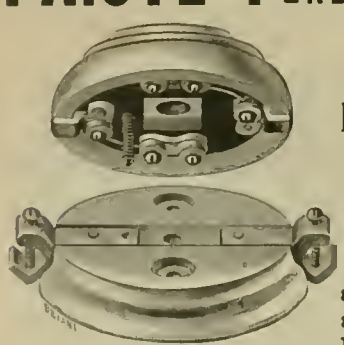

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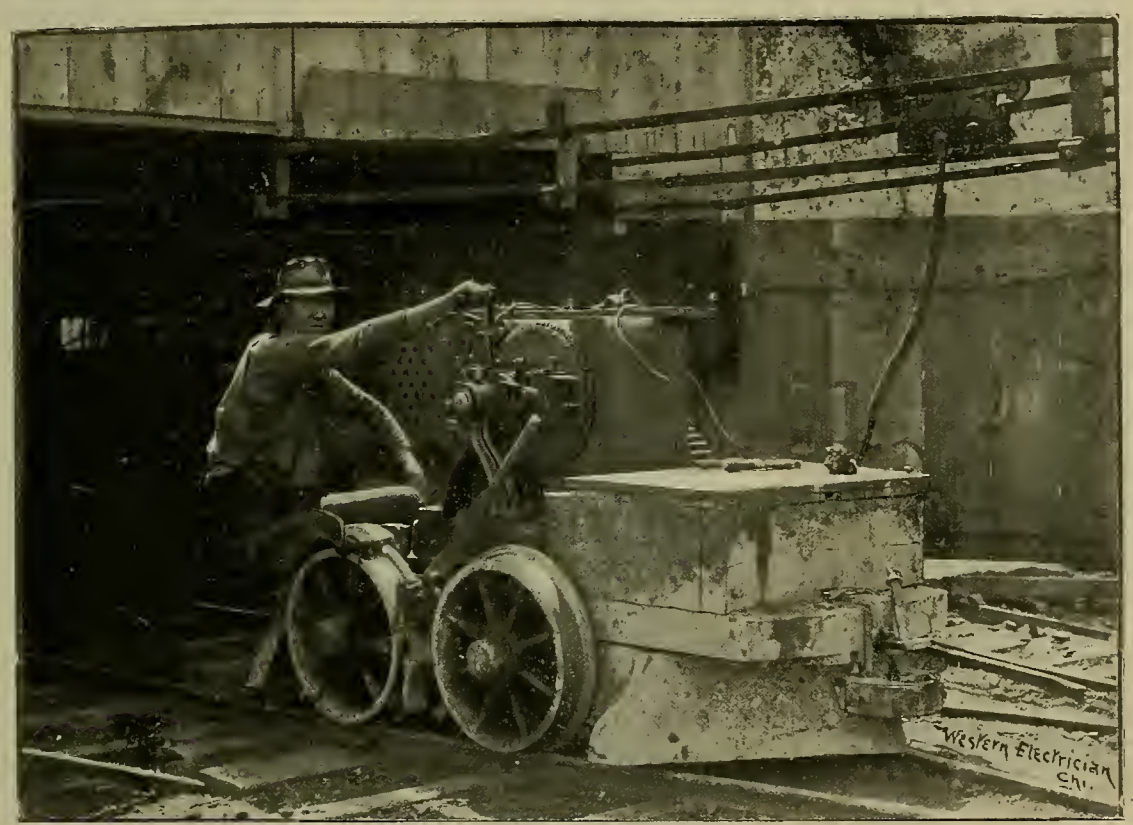
Western Electrician.

EVERY SATURDAY.

Vol. VI. CHICAGO, JUNE 28, 1890. No. 26.

Mining Locomotive.

The accompanying cut illustrates an electric locomotive in service at the Shawnee mine, in Ohio. The motor employed is a constant potential machine and is of 25-horse power capacity. It is series wound. Speed is regulated by means of the resistance box shown in the cut. This box is conveniently placed so that it is a very simple matter to manipulate the contact lever. The reversing gearing consists of a simple rigging, by which a second pair of brushes is brought into play to change the direction of the current through the armature. This locomotive is geared for a speed of six miles per hour. The plant supplying current for the operation of the system is located about 1,200 feet from the mouth of the mine. It consists of a



MINING LOCOMOTIVE.

75-horse power Beck engine, and a 60-horse power 240-volt generator of the Manchester type, built by Foree Bain, Chicago. From the power house copper feeders supported on poles carry current to the trolley conductors. These latter are channel iron weighing three pounds per foot, with a gutter of about 1 inch depth and width. The trolley is constructed as shown and runs between the positive and negative conductors. In addition to furnishing current for the locomotive the plant supplies three electric coal cutters and about 50 incandescent lamps. The cutters are each fitted with a Bain mining machine motor. The lamps are connected, three of 80 volts or two of 120 volts, in series.

The Twelfth Convention of the National Electric Light Association.

At a meeting of the executive committee, held June 16th, it was decided to convene the twelfth convention of the National Electric Light association at Cape May, N. J., on Tuesday, August 19th. Full details of the arrangements made for the convention will be published at a later date. Allen R. Foote has entered upon the duties of secretary and treasurer of the association.

World's Fair Rapid Transit Projects.

The selection of the site for the World's Fair at Chicago is occupying the attention of the people of that city and the country generally. Residents of Chicago are of course deeply interested in this subject, as the decision of the commissioners means much to them in a business way. At present there appears to be an inclination to name the Lake Front as the site. If this is done, the Illinois Central Railroad company will fill in between Randolph and Fourteenth streets, so that the part between these points will be over a mile wide; that is, it will extend from Michigan avenue, east, about a mile and a quarter. The railroad company will be obliged to remove its tracks to the water's edge, occupying relatively the same position that it does now.

In this connection a glance at the rapid transit facilities of the city is timely. The south side cable service to-day can scarcely accommodate the public depending upon it, while the Illinois Central suburban trains have all they can do. There is but one cable line on the North Side, and this is not able to meet the demands of the residents of that populous district. The horse lines are little better than nothing at all, and the west side of the river may, therefore, be said to be positively without rapid transit. Therefore, if the fair is held on the Lake front, as the indications at present point, the north and west divisions will be practically cut off unless something is done to provide transportation for the people of these sections.

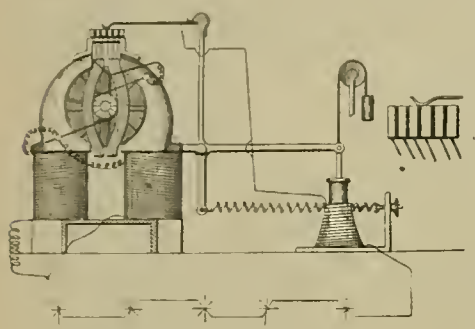
It is reported on excellent authority that the North Side Cable company, anticipating this action on the part of the commissioners, has been preparing plans for an immense tunnel extending from a point north of Ohio street to the exposition grounds. This would be an immense undertaking, but would undoubtedly prove a good investment. An entirely new railroad system will be constructed if this is accomplished, and will, of course, be operated in connection with the present north side system. Electrical engineers will be interested in knowing that the officials of the company favor the introduction of an electric system, provided one adapted to the city's needs can be found. Overhead wires will not be tolerated within the city limits, and the managers will not consider any other system now in the market for surface roads. It is, therefore, suggested that the lines connected with the tunnels be elevated. If this be done, electric motors can be used and the objection to overhead wires overcome. This proposition may seem impracticable on account of the first cost. There is no question that it can be accomplished without much trouble from an engineering point of view. It is conceded that elevated roads must be introduced in Chicago on an extensive scale. Aside from all questions in connection with the fair, it will be necessary for all lines to reach the business center of the city, and the north and west districts can do this only by crossing the river, a plan which of course involves the construction of tunnels. Now, if this is so, steam engines on these elevated roads connected with tunnels must be abandoned. Then there is no good reason why the electric motor should not be operated on the line. It

may be a novel scheme, and it would require a heavy investment in tunnels and elevated structures, but it has many commendable features which deserve careful consideration.

New Regulator for Constant Current Dynamos.

The method of regulating constant current machines, illustrated diagrammatically in the cut, consists in the application of a set of demagnetizing or opposing coils around the armature, in combination with a device for varying the current in the coils or varying the number of convolutions through which the current passes.

In this machine the core of the armature contains so much iron as not to become saturated



REGULATOR FOR CONSTANT CURRENT DYNAMOS.

when under load. The field magnets are wound so as to operate nearly, if not quite, to saturation. The field coils are connected in multiple, and are placed, as shown, in the main circuit. In order to prevent, as far as possible, sudden changes in the magnetism of the fields, Prof. Elihu Thomson, who is the inventor of the regulator, proposes to make the field magnetism the resultant of the magnetizing effect of two or more field magnet coils. These are to be placed in separate circuits having different self-induction. The difference of self-induction in the two coils of the branches may be obtained by giving a different number of turns to the coil. The current which passes in the two coils may be made equal by having the coil resistances equal, or by adding resistance to the coil branch which has the least resistance, as is indicated to the left in the diagram. The main portion of the regulator consists in the stationary set of coils wound about the armature. These when in circuit convey current in a direction to neutralize or tend to neutralize the induced magnetism of the armature as produced by the field magnets. It is only requisite that this opposing action have a value such that under any conditions the machine yields its normal current and an electromotive force just sufficient to maintain that normal current. A moving arm at the top slides over a set of contacts connected with the sections or successive turns of the coils, as shown. This contact-arm is controlled by a lever, actuated by a magnet core against the counteraction of a balance-weight and spring. The last-named coil is made responsive to the variation of the main current. The connections are such that when the current on the circuit increases above the normal, the arm at the top is shifted to bring into action the stationary coils about the armature. This produces an effect which opposes the effect of the magnetism of the field upon the armature, and cuts down the electromotive force. When the current falls, the regulator acts to cut out turns of the stationary coils. This gives stability of current strength under varied conditions, either with all the lights in circuit or with a lessened number.

Atlanta Electric Club.

The Electric club of Atlanta, Ga., has been recently organized, and club rooms have been opened in the business section of the city. They are very tastefully furnished, supplied with incandescent Thomson-Houston lights, very beautifully and uniquely arranged. They were the gift of the local company. A long distance telephone, telegraph instruments connecting with the Postal and Western Union service, call boxes, phonograph and phonographgraphophone have been put in the rooms, and everything has been arranged for the comfort of the members and their guests. The club is composed of all the leading electrical men of the city, and a number of honorary members in other parts of the state.

Double Carbon Arc Lamp Litigation.

The Brush Electric company brought suit in the United States Circuit court in St. Louis last week against the Municipal Electric Lighting and Power company of that city. The suit is instituted to enjoin the defendant corporation from using a double carbon arc lamp alleged to be an infringement on the patents of Mr. Brush. The bill filed by the plaintiff makes allegations substantially the same as those presented in actions previously instituted to restrain companies from using the double carbon arc lamp. It states that the electric arc lamps in use by the defendants, and by them leased to others for use, are substantially the same in their construction and mode of operation as those which have been adjudged to be infringements in other parts of the country; that the Municipal company is now engaged in using and renting large numbers of these lamps, and has realized large profits; that its action has induced and encouraged others to infringe on the right of the owner of the patent; that it has been notified to desist from using or infringing on the right of the complainant, but refuses to do so. The bill also asks for a writ of injunction provisionally restraining the defendants from using the patent during the pendency of the suit.

Machinery Versus Hand Labor.

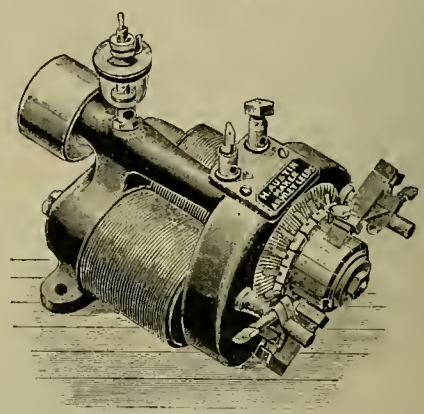
Not content with an extensive application in the higher arts, electricity has found its way into an humbler sphere. The days of the bootblack are numbered, perhaps, and the skillful handlers of the brush must either organize and

MACHINERY VS. HAND LABOR.—ELECTRICAL BOOT-BLACKING MACHINE.

throw a certain machine into the river or be content to labor against "ruinous competition." Our illustration tells the story. An electrical blacking machine is at least a novelty and as the apparatus is the first to be put into service on the streets of Chicago the illustration is of interest. The outfit is simplicity itself. A small C & C motor concealed in a box beneath the foot rest of a boot-black's chair, a flexible shaft with one end attached directly to the armature spindle and the other end fitted with a revolving polishing brush; a small push button beneath the foot for throwing on the current from the Edison system—this is the outfit which seems destined to cause dismay in the hearts of so many of Chicago's little workers in the black art. The gentlemen who hold themselves responsible for any labor trouble which may result from the introduction of their "electrical bootblack" are A. D. Major, inventor, and W. S Gooding, Chicago.

An English Dynamo.

The small machine illustrated in the cut is being introduced, it is stated, in England. It is called an "infant" dynamo, and was designed by H. Austin of Armley, Leeds. The machine is manufactured in sizes ranging from 50 watts



AN ENGLISH DYNAMO.

capacity to 1,000 watts. The armature core is made up of thin Swedish charcoal iron rings No. 18 B. W. G., accurately turned both inside and outside. The sharp corners left on in turning are all carefully ground off each separate ring, which is then coated on both sides by a varnish made up of very thin shellac, in which is mixed fine Paris plaster. The core is then built up to the required depth, the separate pairs of rings, while under pressure, being carefully tested for insulation, and mounted on a strong spider of hard brass. The core is well insulated, and wound in the Gramme fashion

The commutator is made up of segments of brass insulated with asbestus or mica. The field magnet cores are made of Swedish iron, carefully annealed, and are screwed into the pole-pieces—the pitch of thread being almost microscopical—a method which gives a very good contact between the two surfaces. The yokes are very massive, having a sectional area three times that of the cores. The bearings are of very hard phosphor bronze.

The armature can be taken out for examination in a few moments, it only being necessary to take off the nut at the pulley end of the spindle.

The Liesegang Phonograph.

In a recent number of the *Elektrotechnischer Anzeiger* of Berlin, R. Ed. Liesegang, of Freiburg, describes a device which he has invented for recording and reproducing sound. It differs essentially from the American form of phonograph in which the sound record is made on wax

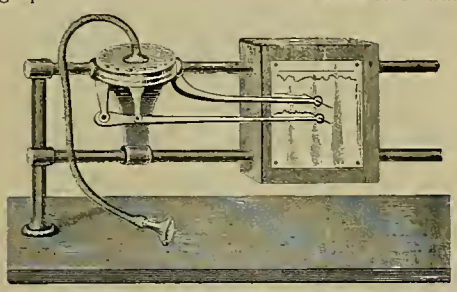


FIG. 1. THE LIESEGANG PHONOGRAPH.

cylinders. In the Liesegang instrument the record may be made on any thin membrane, such as paper. The manner in which the device is operated is shown in Fig. 1. Connected with the diaphragm, as shown in the cut, is a lever at the end of which is a pencil or pen. When the diaphragm is thrown into vibration by the sound waves the pen makes a record on a roll of paper or a pane of smoked glass. When sound is to be recorded the paper or the glass is moved along uniformly by clockwork.

As shown in the cut a second pencil, attached to the end of a rigid arm, describes a straight line on the paper or glass as it is moved along. If the record is to be made directly on paper a pen filled with ink made of a metallic salt which can easily be reduced, is used. If smoked glass is used an enlarged photograph of the lines is made on silvered paper. The lines traced with a metallic salt become metallic in the photographic process, and form conductors for the electric current.

The wave lines, which represent the sound record, are converted into sound waves by means of the device which is shown in Fig. 2. The current of the battery which proceeds from one of the two metallic lines on the paper to the other, encounters a certain resistance, the amount of which is determined by the distance between the lines. The current varies in

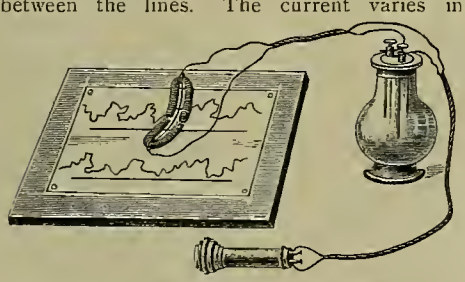


FIG. 2. THE LIESEGANG PHONOGRAPH.

strength, therefore, if the electromotive force is maintained constant.

This difference in current produces in the diaphragm of the telephone vibrations which correspond to the sound record. Speech is thus reproduced. The mode of operation is represented in Figs. 2 and 3. A very thin platinum wire, *a*, which is somewhat longer than the perpendicular distance at any point between the two metallic lines, that is the straight line and the sound record, is used as a resistance. Fig. 3 shows the construction of this portion of the instrument. Fig. 4 is a section through Fig. 3. In this *b b*, is a U of thick copper wire, and *c c*, is of the same shape. These two U-shaped pieces are fixed together and connected as shown, the thin platinum wire in the center being insulated from the copper U pieces by thin strips of gutta percha. The device is made in curved form in order to compensate for the error resulting from the fact that the lever arm describes an arc. In operation this device is laid flat on the paper as shown, so that one of the copper pieces will rest on the straight lines and the other on the sound record. The platinum wire inclosed by the bent copper pieces is thoroughly insulated, and is also in contact only with the lines in the record. The operation of the device will be readily understood. The current first passes, we will say, into the U marked *c c*. It divides, passes down to the metallic line, and feeds in from both sides to the platinum resistance. As the device is of similar construction at both ends the connections at *b b* are necessarily the same. From this it will be seen that the movements of this little curved piece as it passes over the paper with its metallic lines cause the resistance of the telephone circuit to vary according to the amount of wire inclosed between the lines. As the battery is of constant electromotive force, and as the movement of the device over the paper causes variation in the resistance of the circuit, it will be readily seen that vibrations corresponding to the sound record will be produced in the telephone.

Steam Pipes and Electrical Subways.

An ordinance was introduced in the city council of Chicago some time ago providing for the granting of a franchise to a steam heating company operating a system similar to that in New York, Boston and other eastern cities. At that time the WESTERN ELECTRICIAN called attention to the fact that care should be taken to keep the steam pipes at a considerable distance from the electrical subways. The city electrician supported these views, and the petition was referred to a committee where it rests to-day. Several attempts, however, were made to resurrect it, and as the passage of the ordinance would mean the granting of a valuable franchise, it is hardly possible that it will be permitted to rest.

The dangers arising from the laying of these steam pipes under the pavements and their damaging influence on the gas pipes and conduits have already been pointed out. If these statements needed any corroboration, the recent experience of New York would furnish it. The recent terrible explosion on Broadway is attributed to the steam pipes. The latest explosion reported in the New York papers shows that the dangers arising from the operation of this system are not entirely of a monetary character, but threatening to life and limb. Here is an account from a metropolitan daily:

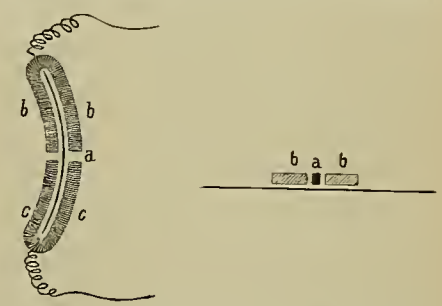
> There was another explosion of the New York Steam Heating company's underground pipes at Broadway and Fulton streets yesterday. The 150 workmen of Knox the hatter had assembled on the top floor to go to work when a hissing sound was heard. A column of steam that had rushed up the elevator shaft burst into the room, and not a man was able to see his hand before his face. There was a rush for the fire escape, tables and chairs were overturned, and the men ran into each other, but all got to the windows and safely down the fire escape. At the same time the steam was filling James Mack's restaurant and kitchen under Knox's store with a hot, vile-smelling vapor. All the material provided for the restaurant had to be thrown away. Several persons who were waiting for breakfast, together with the waiters and cooks, were driven into the street. The pipe which burst was in Fulton street, in front of the store of the Scott Stamp company, next door to the Knox building. The heat cracked the plate-glass window and ruined several stamp albums. In Knox's store the damage was confined to the upper floor. The workmen's clothes were ruined, and their valuable steel implements were covered with rust. Window glass was cracked with the hot steam, and the walls and ceilings on the third floor were ruined. It was an hour and a half before the steam was shut off. The Steam Heating company made an examination of the steam pipes in Fulton street a few days ago. Workmen made a big excavation yesterday, and partly blocked Fulton street all day and all last night.

Commenting on this accident, another New York paper says:

> The frequency with which the company's pipes have been raising sections of lower Broadway of late has led the company to believe that the best way to avoid trouble is to settle the damages at once. A refusal to do so would bring down a perennial line of lawsuits upon them. The street in front of the Knox building is being dug up, so that the leak may be located, and the driveway will be partially blocked for some time to come.

Electricity From Heat.

In the last number of the WESTERN ELECTRICIAN a reference was made to the report that a resident of Hartford had discovered an economical method of generating electricity directly from heat. The most sensational dispatches have been sent from Hartford in regard to the invention. Arthur S. Hyde, a manufacturer of Hartford, was in Chicago last week and was asked for news in regard to the device about which so much has been written. He said: "There is such an invention being developed in Hartford now, but many of the biggest manufacturers take no stock in the new enterprise. Wonders and miracles are claimed for the new process, but little is actually known of it. The machine is supposed to be something like an oil-stove, and from the numerous jets the heat is concentrated, and by some means an electric current is obtained. The owners have

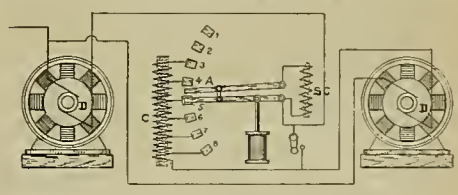


FIGS. 3 AND 4. THE LIESEGANG PHONOGRAPH.

boomed the enterprise as the invention of the age, and more is heard of it outside of the city than in Hartford. If electricity can be made from heat in this manner it is of course a great discovery, but what can be actually done as yet is known only to the inventor—a Mr. Cox from Cincinnati—and a few stockholders. It is certain that the people of Hartford have not gone daft over the invention as I have heard reported."

Method of Synchronizing Alternate Current Machines.

It has been the common practice to make the multiple connection of alternating current generators or motors after the impulses are observed to synchronize, various devices being used for determining the times of synchronism. In the method, which is the invention of E. W. Rice, Jr., of Lynn, Mass., two or more alternate current dynamos or motors which are developing or running on circuits of approximately the same potential difference, may be coupled in multiple at any time without any special preliminary observation. In a few words, the invention consists in bringing the two machines to synchronism by interposing a reactive coil in the armature circuit between the machines to be connected. In order that the operation of the method may be the more easily understood, it may be explained that the electrical activity displayed in this reactive coil depends upon the amount of current flowing through it. This



METHOD OF SYNCHRONIZING ALTERNATE CURRENT MACHINES.

amount in turn depends upon the difference in the phases of the currents passing to the coil. The effect of this action is to retard or accelerate one or the other of the machines until the phases of the impulses coalese, because this is the condition of least resistance in the combined circuits. Referring to the diagram which illustrates the method, *D* is an alternating current dynamo, and *D'* is another and similar dynamo or motor. These are connected, as shown, with a variable reactive coil, *C*.

Switch arms *A* are insulated, one from the other, but are connected through a smaller reactive coil, *S C*. These arms can be moved over

the numbered contact plates. Assuming that the dynamo *D* is running, and it is desired to divide its work with the machine *D'*, or in case it is desired to throw on the machine *D* as a motor, the method of procedure is as follows: The arms *A*, which, when the machine *D* is idle, are supposed to be resting on the contact pieces 1 and 2—that is, open-circuited—are moved, so that the lower arm connects with the contact piece 3. In this position the working circuit of the machine *D* is closed with the circuit from the machine *D* through the reactive coil *C*. This coil, with the lower arm in the position just mentioned, has all its wire in circuit, and is therefore developing its maximum counter electromotive force. Now, by moving the levers from contacts to contacts, a current from one machine or the other is permitted to act gradually so as to accelerate or retard the machines and bring the alternations into perfect synchronism before connection is made through the ordinary conductor of practically no resistance or reaction. If it is desired that one machine shall take a larger portion of the load than the other, the reactive coil *C* may be left in the circuit connecting the second machine. The function of the smaller reactive coil is to prevent sudden fluctuations of the current when the arms are moved over the contacts.

Electric Motor in a Printing Office.

It is well known to printers that the highest class work in engraving and printing requires a power which is at once steady, reliable, and under prompt control. The presses must run with perfect regularity, and at constant speed, and to supply these conditions electric motive power stands unrivaled. In the accompanying cut is shown a view of the press rooms of the Boston Bank Note & Lithograph company, in which all the power used is supplied by a 10-horse power electric motor. This machine is belted directly to the line of shafting running the length of the room from which are run the presses, folders, cutters and other machinery used. Only a part of the presses used is shown in the view, the shafting extending a considerable distance beyond the limits of the engraving. It is interesting to note in this installation the relatively small size of the electric motor, compared with the amount of machinery kept in motion. A steam engine of this size would require from ten to fifteen times as much space without counting the room required for boiler, etc. The motor occupies a space of less than 18 cubic feet.

There are now about twenty Sprague motors used in the city of Boston for operating presses alone, while the total number is in the neighborhood of 200.

Alternating Current Motor.

The accompanying cut illustrates diagrammatically an alternating current motor, recently patented by Elihu Thomson of Lynn, Mass. Rotation in this motor is due to the reaction between an alternating current field and a locally short-circuited armature. This class of motors when running at normal speed is capable of sustaining speed in synchronism, or nearly in synchronism, with the alternations of the feeding-wire, but is incapable of starting.

The invention consists in commencing to run the motor with a different circuit arrangement for its armature from that which it will have under the condition of steady normal working. This primary condition is one adapted to give a torque. When up to speed the motor is run with the armature on continually-closed circuit.

In the accompanying cuts, Fig. 1 is a side elevation of a form of motor to which the invention may be applied. Fig. 2 is a diagram of the circuits and connections of the apparatus. In the figures, *F* represents a laminated field magnet frame having projections upon which are wound coils *C*, as many as six in number. These projections extend inwardly toward a revolving laminated armature. Upon the shaft of the machine is a commutator *K*, consisting of six segments, each alternate segment being connected, so that there are in reality but two divisions of three segments, each fitted together. The armature coils are so connected, that if a continuous current were passed through the coils the projections on the armature would assume alternately north and south polarities. The field coils are connected in a like manner. Now if an alternating current be passed through the field-coils *C*, the motor will not start to rotate whether its armature circuit be practically open, or whether the coils be on closed circuit; but it will continue to rotate in either direction if it is once started, if the armature coils are placed on closed circuit, and the current fed to the coils *C* has sufficient energy. In the motor shown, the alternating current which passes through the field is made at the start to circulate through the armature. In the initial condition of the motor

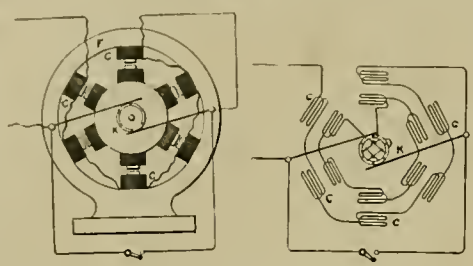


FIG. 1. ALTERNATING CURRENT MOTOR. FIG. 2.

the brushes are set backward or forward into proper position, where the armature will begin to rotate. When a certain speed has been obtained, the motor is made to assume its normal working condition and to continue its rotation without the commutator by short-circuiting the armature by any desired means. These changes of condition may be made by devices manually operated; but the inventor prefers to bring them about automatically by the operation of some device responsive to the change of speed of the armature.

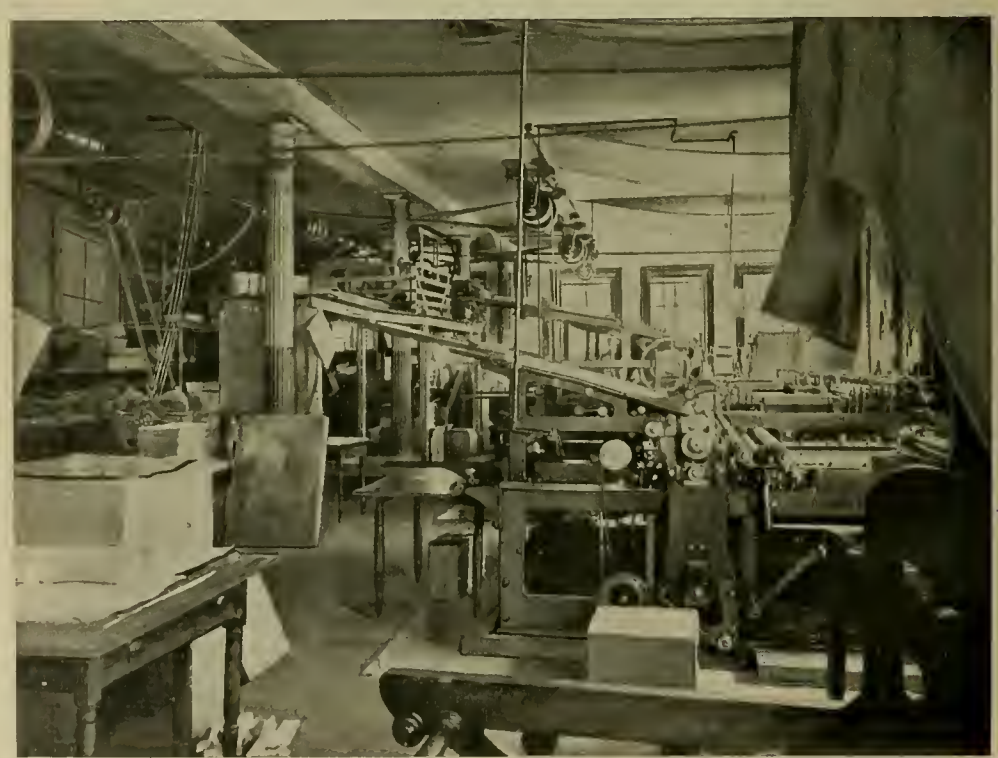
Natural Sources of Power in the Rocky Mountains.

By Frank C. Loring.

That series of mountain ranges extending in almost every direction, but as a whole having a general northwesterly and southeasterly trend, and known as the Rocky mountain system, constitutes the most extensive and the most efficient system of water-storage reservoirs in America. The moisture-laden winds from the Pacific ocean, the Gulf of Mexico and the Mississippi valley after crossing any portion of the Rocky mountain system, become the dry west wind of Colorado, Wyoming and Montana, and the dry east and southeast winds of Idaho, Washington, Oregon, Utah and Arizona. The great elevation, extensive forests and deep canons of the Rocky mountains thus collect and furnish a never failing supply of water to the four great river systems of the west. This supply of water, though varying greatly at different seasons of the year, is constant from year to year and for similar reasons being greatest in the spring and fall, and least in the summer and winter. The waters which form the Missouri, Columbia, Rio Grande and Colorado rivers at the beginning of their journey to the sea form the countless clear and rapid creeks of the mountains. These creeks are never failing and, owing to their great fall and the ease with which they can be appropriated and utilized, afford the cheapest, best, and most tractable water power in America.

The leading industry of the Rocky mountain region is mining. In the mining, concentrating, and reduction of ores much varied, complicated, heavy and expensive machinery is used. In many individual cases several hundred, and in the aggregate many thousands of horse power are used.

It is usually, in fact almost invariably, the case that the situation of a mine is in a locality difficult of access, high up on a mountain or in some side gorge, and if there is a mill of necessity it is separated from the mine. Wherever machinery is used it is usually run by means of steam and often by more than one boiler and engine, one for the mill, perhaps another for the hoist, another for pumping, and still another for power drills where they are used. The use of these drills is becoming more and more general, for in no labor connected with mining is there such a waste of energy as in the pounding of a drill. In short, where power is used its application necessitates many and often minute subdivisions. Where steam is used the vast forests of pine, fir and tamarack furnish the fuel. After the mine has been operated a number of years the question of obtaining fuel is an important one. Soon all of the timber obtainable with a down-hill pull is exhausted and then comes the weary horse-destroying and expensive task of getting wood from below or from a distance. In Gilpin county, Colo., where was once a dense forest, the wood must now be hauled a distance of from eight to fourteen miles, and the cost of hauling is often greater than the original cost of the wood. The wood supply is soon exhausted. Year by year the cost of running the machinery becomes a heavier item in the expense account of a mine. Often it changes dividends into assessments, for it quickly runs up into the thousands. All of this time, while horses and mules are dying, the dividends decreasing and the demands for power increasing,



ELECTRIC MOTOR IN A PRINTING OFFICE.

there is possibly, in fact generally, running to waste perhaps within half a mile, seldom five miles away, power sufficient to run the machinery of the mine ten times over, and its use could be made possible at an original cost certainly no more than that of steam power, and a subsequent cost of almost nothing. In Gilpin county, Colo., there is much more than sufficient water power not utilized within four miles of the mines to supply all their wants.

In no industry can electrical energy be produced so cheaply and be utilized so advantageously as in mining, and nowhere else has it been so little used. The necessity for minute and varied subdivisions of the original power, the contracted space necessitating compact machinery, the changeability of the points of application, the varying demands, the need of pure, cool air under ground where the temperature is usually warm, but above all that the power is furnished by nature in its most economical form, and is free. All portend that enough of the millions of horse power now going to waste will be converted into electrical energy to make steam the rare exception in the near future.

I know of few mines in Colorado, Montana, and Idaho now using steam, within five miles of which there is not many times more power going to waste than will ever be needed. Most mountain streams have a grade exceeding 4 per cent. Taking a stream of 500 cubic feet of water a minute, consider the length of the stream and that there are hundreds of streams carrying many times as much water, and a dim idea of the available natural power of the Rocky mountains can be gotten.

In my own section of Northern Idaho much interest is being taken in electricity in mining. There are now, however, several steam plants in the process of erection or in contemplation, where steam has all of the disadvantages and electricity all of the advantages which I have enumerated.

In placer mining and in reclaiming the vast arid region of the west electricity is bound to be an important factor. There are many high, dry, but rich placers, now valueless, upon which by taking advantage of the flow of some stream, perhaps miles away, water can be forced from some neighboring creek, and ground now valueless can be made to produce thousands of dollars.

Some of the large rivers of the west are in deep canons, back from the brinks of which extend smooth tracts of land having a rich soil, but producing nothing because of no water. A very small portion of the river, perhaps a hundred, perhaps a thousand feet below, would convert the bleak, valueless desert into a garden. By using the power of the stream to pump a small portion of itself to the plains above this can be done. Often the point of taking out the water and the point of utilizing the power are separated, as will often be the case in the Snake river of Idaho. With electricity the problem is solved. The desert is reclaimed. The world is made richer.

Edison Magnetic Separator.

Most of the readers of the WESTERN ELECTRICIAN are aware of the fact that Mr. Edison invented some time ago a process of magnetic separation of material. In this process in which the mingled material is allowed to fall past the poles of a magnet, which alters the direction of falling of the magnetic particles, effectual separation is sometimes prevented by particles becoming massed together. This is especially the case when the particles are very small and light. In the improved separator the inventor makes use of water for causing the dispersion of the particles. The magnets are so arranged that they act by their attraction, not only to separate the magnetic material from the rest, but also to remove it from the water-chamber. The general arrangement of the machine will be understood by reference to the illustrations. In Fig. 1 *A* is a tank having an outlet *C* at one end. At the other end is an inclined board or chute *D*, and above this is the hopper *E* having a slit at the bottom through which the material falls. Below the hopper is a water pipe *F* extending across the tank and provided with a number of orifices at *b*, by means of which a stream of water is directed upon the whole width of the falling stream of particles. Within the tank is a revolving magnet wheel, Fig. 2, which consists of a cylindrical drum *H* of brass or other non-magnetic material. Within the drum is the iron ring *I* having a series of radial projections *K* each of which is wound with insulated wire so as to form electro-magnetic poles. On the same shaft with the drum is a commutator which connects with and through which current is supplied to the magnets of the wheel. These latter are divided into four sets, each containing five magnets in series. The

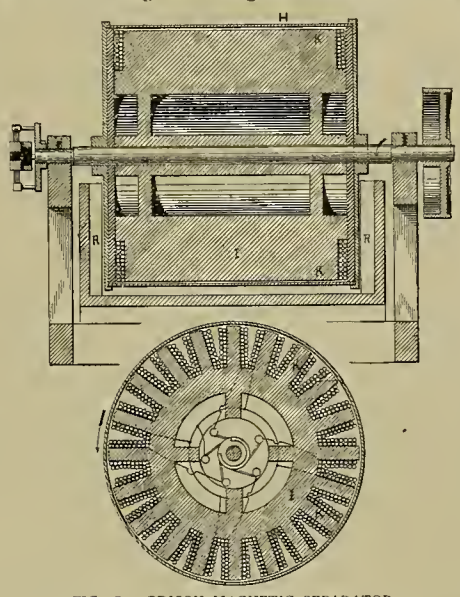


FIG. 2. EDISON MAGNETIC SEPARATOR

connections are such that as the magnet wheel revolves the circuit of each set of magnets is closed for three fourths of the revolution and the commutator is so arranged that the circuit of each set of magnets is broken when it reaches the highest position on the wheel, or thereabout.

The operation of the apparatus is as follows: The hopper being filled with the mingled mass of particles of magnetic and non-magnetic material, discharges in a wide thin stream through the bottom of the hopper into the tank, which is partly filled with water as shown. On falling the material meets the stream of water from the pipe *F*, which assists in separating the particles one from another. Water being constantly introduced at one end of the tank and running out through the outlet *C* at the other end, there is a sufficient current in the tank to carry the particles toward the magnet wheel. In the water the magnetic and non-magnetic particles become completely separated from one another, so that as such particles come within the field of the magnets in the tank the magnetic particles are attracted to the drum *H* and held there, while the non-magnetic particles are carried on by the current and leave the tank through the outlet *C*. The ribs *R* are provided at the sides of the tank to prevent the material from getting past the wheel at the sides instead of passing under it. As the wheel revolves in the direction indicated by the arrows in the drawings, the magnetic particles are carried up out of the water until they reach the mouth of the chutes *P*. As at this point the circuit of each set of magnets is broken the material is readily scraped off and fed away through the chutes.

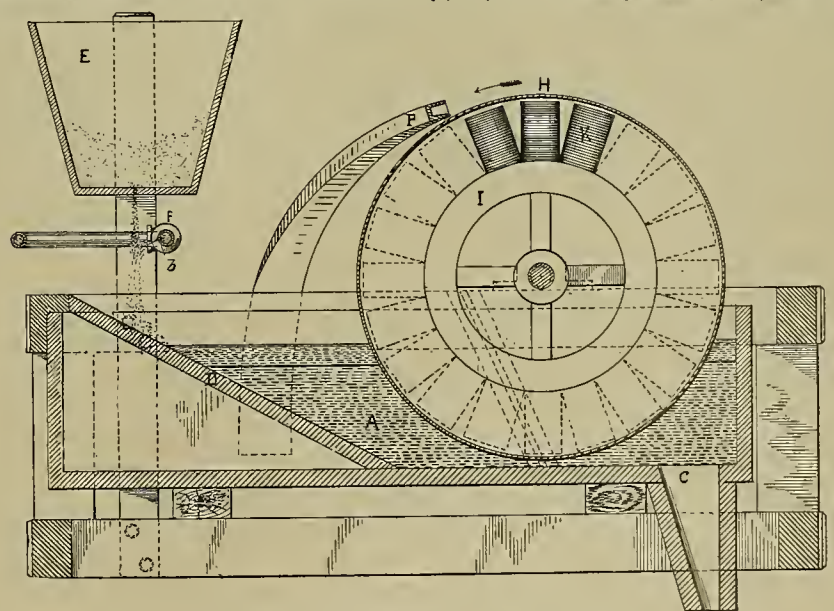


FIG. 1. EDISON MAGNETIC SEPARATOR.

Influence of Electricity in Modern Life.[1]

BY FRANZ BENDT.

The life of to-day has derived its most essential characteristic—rapidity—from the wonderful natural force, electricity. We are living under the sign of electricity; and yet the science that has brought it about is very young. The coming year will witness its twenty-fifth birthday only; for there could be no talk of a technical utilization of electric currents prior to the invention of the dynamo machine. And next year will give us, as has been finally decided, an international electrical exhibition in Frankfort-on-the-Main.

Although Germany was the original home of the telegraph, the methods of quick telegraphy that have done more than anything else to create this age of electricity have been developed in England and America. In the past year the Wheatstone apparatus, which is capable of transmitting from 460 to 600 words a minute, was first introduced into our country. Similar mechanisms are in use in France, among them the Baudot multiple printing instrument, with which from 216 to 252 dispatches of 20 words can be forwarded on a single wire; whereas with the Morse instrument the limit was 25, and with the Hughes instrument 60 messages. These improvements in the apparatus have been accompanied by a remarkable economy in the wires since Siemens, Frischen and Edison have developed the method of multiple telegraphy. It is now possible to send several messages simultaneously on the same wire, and even in opposite directions. In a short time the entire globe will be encircled with the telegraph, as the San Francisco Board of Trade have resolved in favor of laying a Pacific cable by way of Honolulu and Tutuila.

Another memorable advance is the bringing of widely distant places into direct oral communication, as by the Rome and London line that has been in operation since December 1, 1889. During the year 1888-'89 the number of cities provided with the telephone increased from 174 to 200, and the number of telephone stations rose to 38,769, an increase of 7,444.

For generating currents for electric lighting throughout the world about 1,000,000 horse powers are employed, capable of a total illumination of 200,000,000 standard candles. The floating capital employed amounts to $400 000,000. In the United States alone $625,000,000 are invested in the electrical industries. In electrical conduits Germany leads all nations, even the practical Americans, as no less an authority than Edison has acknowledged. Central generating establishments exist in the great cities, not merely for the purpose of supplying illumination, but for conducting electrical currents for other purposes into the houses of consumers; and here a prospect is opened for electricity to play an important part in the domestic and social economy of the future. With the growth in the number of consumers and improvements in insulation and dynamos, the supply of power is becoming constantly cheaper, and the time is not far off when the artisan will be enabled to drive his little machines with the electric current, relieving his muscles, and placing it in his power to develop a manual dexterity that in certain directions can produce results beyond the attainment of manufacturing processes. Thus it is seen that there is virtue in electricity to aid in the solution of some of the social questions that are stirring the world.

[1] Unsere Zeit.

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J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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ANOTHER murderer has been sentenced in New York to die by the application of electricity. August 4th next was named as the day of execution. There are a vast number of legal questions to be disposed before electrocution can be tested, and there is no probability that this new candidate will suffer the death penalty during the summer months.

THOSE who are looking for a revolution to be caused by the Cox invention in Hartford, by which electricity is generated directly by heat, will be apt to discount the sensational reports after learning the opinion of A. S. Hyde, a manufacturer of that city. Mr. Hyde states in an interview presented elsewhere in this issue, that "more is heard of it outside of the city than in Hartford." He was, to say the least, not enthusiastic. "It is certain," said he, "that the people of Hartford have not gone daft over the invention, as I have heard reported."

A GREAT many municipalities lay claim to the name of "electric city," and many of them deserve the honor, but it is questionable whether any one of the number will be able to prove its right to the title after a certain little city in Pennsylvania is thoroughly organized. As our Pittsburg correspondent announces, a town is to be founded by a manufacturing company which is to be electrical from the outset. The streets have been already laid out and named. Among the names are Ampere street, Volt street, Watt avenue, etc. Certainly electricians living in a town which so honors the great names in electrical science ought to be inspired and stimulated.

AT the meeting of the Association of Railway Telegraph Superintendents, of which a report is given elsewhere, a paper was read by W. F. Taylor on electric lighting at railroad wrecks. He gives several interesting illustrations of the rapidity with which the illuminating apparatus was put in operation, and states that the employment of the system has proved invaluable to the company which uses it.

THE executive committee of the National Electric Light association has decided to hold the Cape May convention on August 19th. The official announcement is given elsewhere in this issue. It is stated that many matters of interest will come before the convention, and that the meeting will be unusually enjoyable. The committees are at work arranging for papers of which there will be a number of marked interest to the members of the association.

THE increased adhesion between the wheels of a locomotive and the track caused by the passage of electricity was the subject of a paper read by Charles Selden at the recent meeting of the Association of Railway Telegraph Superintendents. An abstract of the paper is presented in another column. Mr. Selden referred to an electro-magnetic method of increasing the tractive power of a locomotive, but in the main the paper was devoted to an explanation of the theory of E. E. Ries' experiments.

MAYOR GRANT of New York, has ordered that the city axes be sharpened preparatory to another onslaught on the poles in the metropolis. At the last meeting of the Board of Electrical Control he announced that as soon as he obtained the lists of streets in which new pavements had been laid it was his purpose to proceed at once to tear down all poles and wires remaining overhead on those thoroughfares. He added that the companies had had ample opportunity to comply with the policy of the board and place their wires underground. They had been warned from time to time that this rule would be enforced and where they had omitted to avail themselves of the opportunity to get into subways, they must stand the consequences of their neglect. Of course if it is proved that companies have been at fault they will not be the recipients of much sympathy, but it is not entirely clear that the fault does not lie with the subway company, One of the representatives of an electrical company asked the mayor at the meeting if his policy would be modified in cases in which the delay had been caused by the failure of the subway company to provide conduits for the wires. The mayor, if the report is correct, stated that this fact was not essential; he was going to have the pole lines chopped down. In the previous raids on the poles gross mistakes were made and it would not appear that in the coming crusade the rights of the companies are to be respected to any great extent.

EDISON has a rival in the person of R. E. Liesegang of Freidburg, Germany. Another phonograph has been devised, and this gentleman is the creator. The instrument is described in another column. We think, though, the rivalry will not be dangerous. The theory of the action of the new instrument is most ingenious, but unfortunately it has the quality of being impracticable except as a scientific toy. The manner in which electricity is made by the inventor to play a most important part through the agency of the telephone is interesting and suggestive. A record of sound waves is produced on a strip of paper or in the well-known manner on smoked glass. The record is simply wavy lines. It is drawn by a pencil or pen attached to a lever which is moved in conformity to the vibrations of a diaphragm. As the paper moves along, a perfectly straight line at a short distance from the wavy line is drawn on the paper. The two lines constituting the record are then enlarged and so treated that they are made metallic and therefore conductors of electricity. The reproducing apparatus consists of a simple arrangement by which a fine platinum wire may be laid across and brought in contact with the lines and then moved along always in a position perpendicular to the straight or base line. As current from a battery is made to pass from the record lines to the platinum wire and as a telephone is also in circuit it will be readily seen that as the wire is rubbed along over the paper the length of wire, included between the lines and consequently the resistance of the circuit, will vary. The original sound, it is claimed, is thus reproduced in the telephone.

IT seems to be about decided that the World's Fair will be held on the Lake Front in Chicago. By filling in, the World's Fair directors expect to make enough land so there will be abundant space. Inasmuch as the site has been about decided upon, the question of transporting the people to the Lake Front from all parts of Chicago is already being discussed with considerable interest. In an article in another column is presented an outline of one of the rapid transit schemes which a local railway company has under contemplation. It is certainly to be hoped that by the time the World's Fair opens in 1893 Chicago will be utilizing an electric system for operating its street cars. No one now questions that the electric method of moving cars is the system of the future. Within the next year or two it should be adopted on an extensive scale in Chicago. Such a system would be most interesting to all visitors, especially to those from abroad. Unless Chicago can boast of a splendidly equipped electric motor system foreign electrical engineers will almost consider their visit to the World's Fair city a flat failure.

ELECTRICIANS are paying more and more attention to mining work and this field will unquestionably be one of great importance to electrical companies in the next few years. In the present issue of the WESTERN ELECTRICIAN two articles relating to mining will be read with interest. On the first page is illustrated an electric locomotive which is now used in a mine in Ohio. Considerable attention is being devoted, both at home and abroad, to the development of the electric locomotive. Some interesting experiments were recently made with a machine of this kind on the Southwark subway, London. Highly satisfactory results were obtained. With a train of three carriages carrying one hundred persons—the maximum load to be carried by any train when the road is opened for traffic—a speed of twenty miles an hour was obtained and the locomotive alone ran at a speed of thirty miles an hour. It is possible that before the subway is formally opened for traffic in the spring, that further improvements in the electrical plant may be made by which the speed may be still further increased.

Elsewhere is presented an article by Frank C. Loring on the "Natural Sources of Power in the Rocky Mountains." Mr. Loring is a resident of Wardner, Idaho, and as he has investigated very carefully the subject of which he speaks, his views will be read with interest. The creeks of the Rocky mountain region, he says, afford the "cheapest, best and most tractable water power in America." He speaks of the great objections to the use in mines of steam power, which is at the present time generally employed, although there is "generally running to waste, perhaps within half a mile, power sufficient to run the machinery of the mine ten times over." Were a plant for utilizing the water power installed, the original cost would be no greater than in the case of steam, while the subsequent expense would be almost nothing. Of the advantages attending the employment of electric motors in a mine, Mr. Loring says: "In no industry can electrical energy be produced so cheaply and be utilized so advantageously as in mining, and nowhere else has it been so little used. The necessity for minute and varied subdivisions of the original power, the contracted space necessitating compact machinery, the changeability of the points of application, the varying demands, the need of pure, cool air under ground where the temperature is usually warm, but above all that the power is furnished by nature in its most economical form, and is free. All portend that enough of the millions of horse power now going to waste will be converted into electrical energy to make steam the rare exception in the near future."

The Association of Railway Telegraph Superintendents.

The ninth annual meeting of the Railway Telegraph Superintendents' association was held at Niagara Falls, N. Y., on June 18 and 19. The following members were present: C. A. Darlton, president, Washington, D. C.; P. W. Drew, secretary, Chicago, Ill.; C. W. Hammond, St. Louis, Mo.; C. Selden, Baltimore, Md.; A. R. Swift, Chicago, Ill.; G. L. Lang, Boston, Mass.; G. C. Kinman, Decatur, Ill.; G. T. Williams, Cleveland, Ohio; M. B. Leonard, Richmond, Va.; R. Stewart, Elizabeth, N. J.; A. Ramseur, Atlanta, Ga.; I. T. Dyer, St. Joseph, Mo.; U. J. Fry, Milwaukee, Wis.; H. C. Reed, Milwaukee, Wis.; J. B. Stewart, Weehawken, N. J.; M. Magiff, St. Albans, Vt.; W. J. Holmes, New York, N. Y.; W. W. Nichols, Chicago, Ill.; W. F. Taylor, Altoona, Pa.; O. C. Green, St. Paul, Minn.; W. E. Lewis, Long Island City, N. Y.; H. C. Sprague, Kansas City, Mo.; C. M. Dugan, Jackson, Tenn.; L. B. Foley, New York, N. Y.; C. B. Jones, Chicago, Ill.; A. R. Singafelt, Topeka, Kan.; E. A. Smith, Boston, Mass.; S. K. Bullard, Sedalia, Mo.; T. W. Stacey, Marshall, Tex.

The first session of the meeting was called to order by President Darlton on Wednesday at 10:15 a. m. After the reading of the annual report the following new members were elected: J. C. Ford, St. Paul, Minn.; W. J. Stonebromer, Two Harbors, Minn.; H. D. Milton, Texarkana, Tex.; J. V. Goode, Kansas City, Mo.; P. H. Hough, La Crosse, Wis.; G. N. Gish, Marshalltown, Ia.; H. B. Briggs, Redwing, Minn.; T. W. Parks, Tyler, Tex.; J. N. Miller, Dallas, Tex.; W. D. Hendrickson, Long Branch, N. J.; B. R. Pollock (the world champion sender), Hartford, Conn.; and L. Horton, Jr., St. Paul, Minn.

The following officers were elected for the ensuing year: George T. Williams of Cleveland, president; George M. Dugan vice-president; P. W. Drew of Chicago, secretary and treasurer. M. B. Leonard, Charles Tilden and G. C. Kinsman were appointed a committee on time and place of next meeting.

As the attractions of Niagara are available only by daylight, it was decided to devote the afternoon to a tour along the American and Canadian shores of the falls and rapids, and substitute an evening session for that usually held in the afternoon.

The first paper of the evening, of which the following is an abstract, was read by Robt. Stewart, Supt. of the C. R. R. of N. J., on the "History and Development of the Block System." Mr. Stewart was the first railroad telegraph superintendent to introduce this system of signaling in America. He was at the time connected with the Camden & Amboy railroad, over which nearly all the Eastern troops passed during the war. A rear collision, which occurred at Bristol, Pa., in the summer of 1863, causing the death of a large number of soldiers and the fireman of the engine, led to an investigation of an English block system, and Mr. Stewart was instructed to experiment with and put in use a signal by which trains could be notified without being stopped on the track whether the next point was clear. After some experimenting he placed in operation 7 block stations upon the 25 miles of road between Trenton and Kensington, using the banner signal in conjunction with the regular telegraph offices. There were two fixed glasses, the upper two white and the lower red, with two independent lamps, one for east and one for west bound trains, which were operated by hand, with a rope attachment. This arrangement proved defective, and a single lamp with a movable red flannel shield was substituted. A record of the trains was kept on a board with pegs. The telegraph operators used the regular Morse system for notifying adjacent stations that trains were in or out of the block. The experiment proved so successful that it was extended from Trenton to New Brunswick, covering 26 additional miles of road in 1864. Shortly after, upon the formation by consolidation of the united railroads of New Jersey, the system was extended to Jersey City, making it complete from Philadelphia to Jersey City, excepting between the cities of Newark and Jersey City. In 1870 a connecting road from Frankfort Junction to Mantua was equipped, making a total distance of 90 miles. From the establishment of this system up to the date when the road was leased by the Pennsylvania Railroad company no rear collisions of any kind occurred, a clear record which be attributed to the fact that only the "positive" block was used, in distinction from the "permissive" block, afterward introduced by the Pennsylvania Railroad company, by which two trains were permitted upon a block at the same time, by observing caution. In 1873 the Pennsylvania R. R. began the introduction of the system to a limited extent, on the Pittsburg division of the main line. Its extension was very slow until the winter of 1875-6, when it was rapidly extended over the entire main line. Its use was stimulated by the approaching Centennial Exhibition, and in spite of the enormous increase of traffic, the protection was so complete that no accident occurred, which could be attributed to its failure. As originally introduced, the blocks were of considerable length, depending upon local conditions; but on the main line the distance varied from six to ten miles. The signal now used is the standard semaphore. The Pennsylvania R. R. Co. has now a continuous block system from Jersey City to Pittsburgh and from Philadelphia to Washington, the most extensive in this country, also on the Northern Central division. The officers pronounce it a great success, and an absolute necessity to the road. On the C. R. R. of N. J., the electric pneumatic block signal system of the Union Switch & Signal company, was put into operation in April, 1890, between Jersey City and the Newark Bay draw, a distance of eight miles. The blocks ranging from 1,000 to 1,800 feet are operated on four tracks. At the commencement of each block, signal posts are erected, one for each track, carrying two semaphores. When the upper semaphore is at right angles, it indicates that a train is on the next block. When it projects in this way, the lower one is also set as "danger" or "caution." As the train leaves the block thus protected, the upper signal falls, but the lower remains at caution until the next block is passed and the train is two blocks distant. These semaphores are operated by pneumatic pressure controlled by electricity. Those on one block are insulated from the preceding and following blocks. At one end of the block first touched by a train, the right and left hand rails are connected by a wire connected in the circuit of two cells of gravity battery. At the other end of the block the same rails are connected through an ordinary relay. When no train is on the block a current passes through this rail circuit holding the armature of the relay in contact, forming a circuit for the local battery. When a train enters the track its wheels and axles short-circuit the battery, releasing the armature of the relay and breaking the local circuit, which has a battery of eight cells. The local battery operating the semaphore magnet, when its circuit is closed forces open a valve which admits compressed air into the semaphore cylinder and the piston is driven down forcing the semaphore into a "safety" position. With the entry of a train upon a block the relay being thrown out of action the local circuit is opened and the semaphore is drawn by weight into "danger" position. Where the "home" and "distant" signals are both operated under these conditions, the arrangement of circuits is more complicated. The supply of compressed air is furnished by a plant of compressors communicating by pipes with a series of reservoirs placed along the lines at the foot of the signal poles, and pipes are connected from there to the semaphore signals. The ordinary ties are found to afford sufficient insulation for the rails, but the fish-plate joints not being ample, conductivity is re-enforced by iron wire connections. Between the blocks the rail ends are insulated.

Mr. Stewart then described the various systems of block signals which had been actually introduced, beginning with the Hall system which was first used on the eastern railroads in 1871, and has since been greatly improved. The Chicago, Milwaukee & St. Paul Railway company has a block system in operation on 146 miles of its Chicago and Council Bluffs division, using double arm semaphores placed in a position to be seen from both directions. It is operated by hand in connection with an ordinary Morse telegraph. The cable electric signal is being experimented with on the Staten Island Rapid Transit Road. The Chesapeake & Ohio Railroad use a system similar to that of the P. R. R., covering all tunnels and trains going down both sides of the Allegheny Mountains, using the Hudson semaphore signal.

The Chicago, Burlington & Quincy has practically three different systems in use, all non-automatic, the difference being mainly in the manner of connection between offices. The main line from Chicago to Pacific Junction, 482 miles, is now operated, under what may be called the "permissive" block. The New York Central Railroad has begun the introduction of a pneumatic-electric system on that part of its track between Woodlawn Junction and the Harlem River, the same as that used on the Central Railroad of New Jersey. The New York Central is also equipping fifteen miles of track near Poughkeepsie with the Hall system. The New York, Lake Erie & Western uses a block system on 232 miles. Other railroads using various block systems are the Boston & Maine, Philadelphia, Wilmington & Baltimore, the Missouri Pacific, the Canadian Pacific and the Lake Shore Railroads.

In closing his explanatory paper Mr. Stewart said that the system of blocking trains has and could be improved, and that the time is not far distant when upon all the main trunk lines of the country the business will have grown to such an extent that in order to move all trains at a higher rate of speed, especially freights, it will be necessary to locate signal towers at such distances as will permit the use of the "absolute" block to govern all their movements. Speed and safety are so closely allied in the successful operation of railroads, that whatever tends to their accomplishment the progress of the times would not permit to be ignored. If a simple and inexpensive automatic system could be devised for operation between the main block stations, a long step in advance would be taken. "Permissive" signaling might then be used with absolute safety at the main stations, as the auxiliary would act as an "absolute" intermediate block.

Charles Selden read a paper upon the increased adhesion between the wheels of a locomotive and the track caused by the passage of electricity, based upon the experiments and patents of Elias E. Ries, of which the following is an abstract:

"From competent authorities on motive power, it has been determined that a locomotive, having a weight of 100,000 pounds, has a tractive power upon the rail, when in best condition, of but 25,000 pounds. And when the rail, by reason of the weather, is in a bad condition, the tractive power amounts to only about what an engine of 15,000 pounds' weight should have. In other words, on good rail, by non-adhesion, the locomotive gives but twenty-five per cent. and on bad rail, but eighteen per cent. of the power which, theoretically, should be had from it.

"Efforts were made some fifteen years ago, by an Englishman named Wederman, to overcome the non-adhesion, by winding the spokes of the driving wheels with wire, thus making a magnet of the wheel, with the view of attracting, by magnetism, the wheel to the rail, thus increasing the friction, and, thereby, the adhesion to the rail on the part of the locomotive. Having but a primary battery, it is plain to be seen that the results were so slight as not to be appreciable. There was another objection, even had the dynamo been used. In order to secure sufficient magnetism to be of benefit upon such an immense machine as a locomotive, the magnets would have to be very large, and the winding upon the spokes of the drivers would have necessitated a change in the construction of the engine, so that as the bobbin was revolved by the wheels there would be room to clear the firebox on the inside and the side-rods of the locomotive on the outside. This, of course, would render necessary a longer crank pin for the bars, and, being longer, it must necessarily be stouter in order to stand the increased leverage. A device of this character therefore, for the locomotive engine would not be economical, and would necessitate the reconstruction of all locomotives using it. This inventor filed patents in this country and several others followed in his footsteps, but nothing practical has yet been evolved from that method.

"Recently, Elias E. Ries, an American inventor," the paper continued, "secured letters patent upon his method of increasing the adhesion of the locomotive to the rail, by the use of electricity, and he took a wide departure from the path pursued by former inventors. Mr. Ries proceeded upon the hypothesis that an electric current of large volume, if properly employed, could be used to weld metals. Acting upon this theory, he proposes to arrange upon a locomotive a dynamo of sufficient power to be run by a small auxiliary engine, and to pass the current from the dynamo, to the driving wheel of the engine along the rail to the next driving wheel, through its axle and the other wheel, to the other rail and back to the first driver, thence to the dynamo, thus making a local circuit, so to speak, which would travel with the locomotive, passing a current through the drivers and along the rails as indicated. For this purpose, by a very simple method, he insulates one pair of the driving wheels. By this means the inventor proposes to cause an incipient weld between the driving wheels and the rails. I say incipient because the wheels, being in motion, the weld, if any, is being made and broken by the revolution of the wheels, therefore a perfect weld is not attained; nor, of course, would it be desirable except for brake purposes, as in descending a grade for instance.

"If the theory advanced by Mr. Ries can be made a success, practically, it means a great many things to the railroad world. If by means of this invention the tractive power of a locomotive is increased, say even twenty-five per cent., it means ten additional cars on a forty car train. It means a large gain in the hauling capacity on high grade railroads. It means increased speed for passenger trains. It means a saving, indirectly, of fuel. It means the employment of lighter locomotives to do the same amount of work as the heavier ones, thus being easier on the road-beds and bridges. It means the mounting of grades that would not be considered possible at the present time. All this, provided that in practice on a locomotive the theories advanced shall hold good. Another feature of this invention is that it is not necessary to keep the current flowing all the time unless you need it, but when you stop the train and want to start it, your locomotive, at that time, not being in motion, a more perfect weld is obtained thus enabling you to start at once, without slipping, and after you have gotten your train under headway, your current, if desired, may be switched off. So much for the pulling power and so much for the motor."

The statements made by Mr. Selden were questioned by Mr. Nichols, and a model motor and track were introduced to prove the assertions claimed by the inventor. The experiments made were entirely satisfactory and convincing to the most skeptical—the only question being as to the practicability and economy of the application on a large scale.

W. F. Taylor followed with a paper on "Lighting at Wrecks." After referring to the importance of powerful artificial lights to facilitate the clearing away of wrecks at night, Mr. Taylor gave a description of the electric light car used by the Pennsylvania railroad. The car itself was an ordinary box car, having an end door with a small extended platform and windows. A 15 horse power boiler at one end is surrounded with water tanks of 800 gallons, capacity. Near this is a coal box holding two day's supply of fuel. At the opposite end of the car is a 15-horse power Westinghouse engine, making 300 revolutions per minute. Near the center of the car is a 10-light Weston dynamo making 1,000 revolutions per minute. Suitable receptacles are provided for tools, lamps, etc. On one side of the car two reels of wire are permanently fastened one of which contains a wire which is run out as a feed wire, the other being connected to the last lamp of the circuit and is used as a return wire. The lead wires are connected with a brush which connects with the axles of these reels, thus giving a path for the current. Upon the top of the car are carried tripods and tools for hanging the lamps. The car is manned by a crew of one engineer and four linemen. In starting for a wreck the regular crew is always preferred as the men are thoroughly drilled. Arriving upon the grounds the first thing is to locate the car, then determine the number and location of the lamps. Then a man is started out with the end of wire from the small reel, followed by another carrying pole, a pike and hammer, or tripod, as required; then the third man with the lamps and a short section of wire, continuing till the last lamp is reached, when the wire on the larger reel is run out and connected with the last lamp, thus completing the circuit. The lamps are swung from the most available points, portable poles being used if necessary. These are usually made of 4x4 hickory 18 feet long with the lamp. At the bottom a piece of 1-inch gas pipe is clamped to the pole. To erect the pole a steel bar is driven into the ground, and the pole is then lifted up so that the gas pipe will go over the steel bar. In the bracket at the top of the pole is a pulley through which a rope passes and thus draws up the lamps. The pole is more easily handled than a tripod. The time occupied in starting up the lights is shown in the following instances: Wreck No. 1, 7 lamps, ⅝ mile of wire—started in 1 hour; No. 3, 7 lamps, ½ mile wire, 1½ hours; No. 4, 6 lamps, ½ mile wire, 35 minutes. The cost of equipping a car ready for service was about $2,500. In operation it costs about $1 per lamp per hour, but even if it cost $5 per hour it would be worth it.

Papers were read by Mr. Leonard on "Electric Lighting in Railway Service," by Geo. C. Kinman on "Train Despatching, its Uses and Abuses," and "Correct Time, How Shall we Maintain it?" by Prof. H. S. Prit-

chett of Washington University, St. Louis. The meeting adjourned Thursday evening to meet next year at Cincinnati

There was a larger number of exhibitions than usual, among them being the Hall signals, Edison phonoplex system, O'Neill crossing signal, Edison Lalande battery, and those of the Electric Secret Service company, Pennsylvania Steel company, Molecular Telephone company, P. B. Delany and the Desart Electric company, the Brown Electric Protective company, Philadelphia, Pa.

Opening of the Electric Railway in Indianapolis.

The electric cars of the Citizens' Street Railroad company of Indianapolis made their first trip last week. On the trial trip several trains were run, which were occupied by guests of the company. A band occupied one of the cars. "The ride to Fairview was greatly enjoyed, as the rapid travel after getting out of the crowded part of the city gave a cool breeze," an Indianapolis paper says. "The pretty scenery and nature in her greenest hue had a restful effect. Scudding smoothly through wooded lanes and around the sharp curves, now laboring up hill or speeding down grade, watching the approaching train around the curve, moving by invisible power—were noticeable features of the trip, which awakened emotions of pleasure. In order to have everything work as smoothly as possible, the best motor men of the Richmond line were brought over, and placed in charge. They handled the cars dexterously and safely."

The annual meeting of stockholders of the Citizens' Street Railroad company resulted in the re-election of the following directors: Samuel W. Allerton, J. J. Mitchell, E. K. Butler and W. B. Walker of Chicago, and J. C. Shaffer of Indianapolis. The reports of the president and treasurer were submitted, showing a highly satisfactory condition of affairs. The directors organized by re-electing the old officers, namely: President, J. C. Shaffer; vice-president, Samuel W. Allerton; secretary, A. A. Anderson; superintendent, Wm. T. Steele The stockholders went over the various lines during the day.

"We are all much pleased with the working of the new line," said J. P. Rumsey, one of the large stockholders, "and believe that it is going to run smoothly. This line is going to develop a fine territory, and greatly increase the value of property along it. In a short time it will all be built up with pretty homes. It also furnishes the city with something heretofore lacking, that is, a means of getting to the country without having to depend on horses and carriages. This will be greatly appreciated by thousands of people who heretofore have been unable to get a breath of fresh air, because they could not afford to hire carriages. There will soon be a demand for rapid transit over all the lines, and that will work a disadvantage to us because we cannot afford to make the desired change until we are assured that the situation warrants such an extensive investment." The Thomson-Houston system is employed.

The Copper Age.

A large part of Boston smiles when copper stocks rise says the Boston *Transcript* Our numerous shareholders in Michigan mines feel that it is a legitimate boom that larger demands for the metal are now causing. Here are a few illustrations of the increase in the demand, as witnessed in operations in progress in this city. There is the Edison Lighting company now taking its innings at digging up Boylston street. During the past four years they have been extending their underground system in the Back Bay district and about Fort Hill square Each foot of piping put down for this purpose contains five pounds of copper. In the first three years about twenty miles were laid; while during the present spring as much again has been put down. This means a total of 530 tons of copper buried in our streets by this one company, or 265 tons in the year just past. There are many other cities where as much more has been done by this company, and several other companies which have not been idle in new construction. The telephone companies are also being forced to bury their wires. This system requires copper wire The New England Telephone & Telegraph company at the close of 1888 had but 1,580 miles of line buried; at the end of 1889 it had increased the underground mileage to 3,599. This means about 260 tons more of copper put back into mother earth. Another voracious consumer of copper is the long-distance company—the American Telephone & Telegraph company—with about 30,000 miles of line in Eastern United States, of which 10,000 miles, more or less, are last year's construction. One hundred and eighty pounds of copper goes into the mile of wire used by this company. This would represent about 900 tons. Then, again, there are the electric railroads. The Thomson-Houston alone is credited with putting 574 miles of this kind of road in operation within the past two years Each mile of wire used weighs 1,682 pounds, while each mile of single track road requires two of wire, one overhead and one buried in the ground; with double track roads a single underground wire suffices for two tracks, three miles only being required for one mile of double track. Twenty-five thousand pounds would be a proximate estimate of wire per track mile. Here, therefore, was use for about 718 tons of copper in two years. Of the consumption in other branches of manufacture of the new electrical appliances it seems impossible to make any definite estimate; but suffice it to say that one Boston firm who have a peculiar process for insulating wire for electrical purposes admit that they cover 1,500 tons per annum. All these are among the new uses of copper, be it remembered, and represent only the additional call upon the Michigan production; and the old standard uses continue the same as ever.

Sugar in Battery Work.

A correspondent writes to the *Victorian Electrical Telegraphic Journal* as follows: "I became aware of a wrinkle lately that I am confident will be a novelty to many of your readers, and also of use. One of our telegraph inspectors gave it to me. He came to my station, and found that the battery was not up to his idea of what a battery should be. He took it down, and renewed it. When it was put up again he asked me to favor him with a little sugar. Surprisedly I asked him what he wanted with sugar, thinking he had made some mistake. He quietly laughed, and said, "Get some, and I will show you what it is for." It was got, and he began to wash his hands in the usual way with soap and water, but after rubbing the soap, he added the sugar, and immediately a good lather came. He washed his hands twice, and told me to do likewise. I did, and to my pleasure my hands came out of the wash clean and soft He told me always to do so when working with magnesia or copper-solutions, and the nasty dry feeling that usually is experienced when working with a battery is quite done away with.

An Optical Feature of the Lightning Flash.[1]

By Eric Stuart Bruce.

In the first report of the thunderstorm committee, which dealt with photographs of lightning flashes, the committee called attention to the fact "that there is not the slightest evidence in the photographs of lightning flashes of the angular zig-zag or forked forms commonly seen in pictures." They also referred to the paper that James Nasmyth communicated to the British Association in 1856, in which Mr. Nasmyth says that a flash of lightning appears to him to be more correctly represented by an intensely crooked line, and he seems to doubt the existence of artist's lightning. To these apparently conclusive condemnations of the conventional idea of a lightning flash might be added the words of Mr. Ruskin in "Modern Painters," when criticising Turner's "Stonehenge." He says: "The white lightning, not as it is drawn by less observant or less capable painters in zig-zag fortifications, but in its own dreadful irregularities of streaming fire" It is noticeable that these words were written of Turner's picture many years before the publication of Nasmyth's paper.

But on the other side there was the evidence of one's own eyes, and those of many others, as having at times seen a zig zag flash something very like the depiction of the artist, added to a conviction that in the conventional representation handed down from ancient times there is probably some element of truth.

It occurred to me that the explanation would be found not to be an optical illusion, but an optical reality—not the flash itself, but the optically projected image of the flash formed on clouds. But why should the projection flash be in angular zig-zags? Because the clouds on which the projection is cast are often of the *cumulus* type so as to afford an angular surface.

The image of the flash takes the angles of the uneven surface of the clouds. Having formed this theory in my mind, I proceeded to experiment, and succeeded in reproducing something very like the conventional lightning by casting the projection of a photograph of lightning on model clouds.

I have arranged on the table some model clouds presenting an angular surface.

Let the incandescent lamp represent a flash of lightning at some distance from the screen of clouds. When the light is flashed on and off, there is the simulation of sheet lightning on the cloud screen; now to transform the *sheet* lightning into *projection* lightning. To do this there must be an addition to the arrangements—a cloud with a small opening in it, somewhere between the flash and the surface of cloud upon which the projection is cast. Let a screen with one small opening represent such a cloud; when this is placed in position and the light flashed on, there is no longer the sheet lightning, but the image of the incandescent carbon—a distorted image as it falls upon the uneven surface of the clouds. The sides of the horseshoe of white hot carbon appear to be zig-zagged.

And now to go one step further. If we make another opening in the model cloud, there will be two images formed of the incandescent filament of carbon, and likewise in nature a multiplication of openings will produce a multiplication of images of flashes May this not explain the forked appearance so often depicted?

It may be objected that it seems inconceivable how this peculiar type of flash came to be regarded as the only type; for the image is probably not nearly so frequently seen as the flash itself. Perhaps the fact that the image of the lightning flash would not have that intense and dazzling the brilliancy of the flash itself may explain this.

If any brilliant source of light, such as the arc light, be suddenly flashed upon the average human eye, that organ would not recognize the form of the source; but if the image were not flashed upon a screen, any eye would distinguish the image of the white hot carbon points, and so the projection would lose the bewildering brilliancy of the flash, and its distorted form would be impressed upon the mind. The diminution of brilliancy probably also explains that other objection—that no photographic plate seems to have yet registered the zig-zag "projection" flash.

[1] Abstract of paper read before the Royal Meteorogical Society, London.

The Julien Storage Battery.

The Consolidated Electric Storage company of New York has just issued a circular, in the course of which it says:

"We take this means of informing you that this company has been organized for the manufacture and sale throughout the United States of the Julien storage battery. To that end, it has acquired those storage battery patents which, in its opinion, control the manufacture and sale of storage batteries for the United States. In order that you may understand the scope of those patents, we will describe in a few words what constitutes a storage battery as at present universally made. Gaston Plante, whose storage battery was the first to attract public attention, used the following method: He employed two plates of lead, which he immersed in a solution of sulphuric acid and water; he then applied a current of electricity which had the effect of creating on the surface of the plates, by disintegration of its substance, a spongy substance, known as active matter or absorptive material, being spongy reduced metallic lead on one plate and peroxide of lead on the opposite plate. This process required several weeks and sometimes months of charging, involving too much labor and expense to make the Plante battery one of commercial value. Radical and fundamental improvements were needed to make the storage battery what it is to-day. To Charles F. Brush of Cleveland, O., has been awarded, both by the United States Patent office and the United States Circuit court, priority of invention of those improvements. * * * Mr. Brush applied for patents for his inventions He was put in interference with Camille A. Faure, who made similar claims to invention, and after a long and bitter contest for a period of four years before the patent commissioners, Mr. Brush was awarded priority; and on March 2, 1886, United States patent 337,299 was issued to him. This patent covers broadly the mechanical application in any form (whether powder or paste) of the active matter or absorptive substance to a support plate. This is the decision of the United States Circuit court in the case referred to. Any method of application by hand or machine is 'mechanical.' The court also decides that the words 'active matter' and 'absorptive substance,' as used by Mr. Brush, are synonymous, and include not only lead oxides but every other substance that is absorptive (and it must be absorptive to be of any value), applied to a 'conducting support.' It does not matter what shape or size the conducting support may take, whether it be smooth, perforated, woven wire, flat, cylindrical, etc., so long as it is a 'conducting support,' it is an infringement of the above patent. In addition to this broad invention, this patent also covers, expressly and by specific claims, the support coated with mechanically-applied metallic oxide, oxide of lead or equivalent lead compound, and red lead, and also such a support when provided with 'receptacles' filled with the mechanically-applied oxide of lead or other active material. The word receptacles was found by the court to include perforations extending through the plate.

"This patent has nearly thirteen years still to run, and is controlled by this company. Another important patent now controlled by this company was sustained by the United States Circuit court, viz.: Patent No. 266,090, covering a support with 'cells,' 'cavities,' 'slots' or 'perforations,' and the words 'cells or cavities' were held by the court to include perforations as well as cavities of other forms.

"Patent No. 260,654, also controlled by this company, covers the application of the 'absorptive substance' to the 'conducting support' by 'pressure,' whether exerted by hand or a machine. * * *

"This company has also acquired United States patent of Edmond Julien, No. 347,300, covering an inoxidizable conducting support. * * * To guard against imposition by persons who may pretend to have discovered a new battery, we wish to inform the reader that it is universally admitted that so far as scientific research has gone, only the metals and their salts (metallic oxides), may be employed to make a commercially useful storage battery, and only those metals and their salts may be employed which are practically insoluble in the electrolyte. The elements or electrodes of a commercially useful storage battery consist of two parts—first, a 'support,' and second, an 'active' or 'absorptive' substance applied and secured to the support. Gold and platinum, but for their costliness, would be the most useful metals to employ for the support, as they are practically inoxidizable in the electrolyte, or exciting fluid or solution of the battery. Of all the cheaper base metals, lead possesses in the highest degree this immunity from attack by the exciting fluid or solution, and for this reason it has been chiefly employed where a simple metal has been used for the support plate.

"The alloy of lead, antimony and mercury patented to Edmond Julien is, however, far superior to lead in this respect, and approaches more nearly than any other metal or alloy, the cost of which would permit its use, to gold and platinum.

"Many attempts have been made to use various metallic compounds for the active or absorptive substance to be applied to the supports These have been applied in various ways, but no commercial success has yet been reached by any experimenter in the use of any substance or by employing any method of application except reduced (or spongy) metallic lead and its oxides, mechanically applied and secured to the support plate.

"This company has also acquired United States pateot

No. 383,757 and 408,986 of Henry G. Morris and Pedro G. Salom. Messrs. Morris & Salom have been engaged, for some years past, in devising suitable machinery for the effective and economical manufacture of storage batteries. These patents cover a machine known as the mechanical filler. Prior to the invention of this machine, the active matter was applied to the 'conducting support' by hand. The method was laborious and expensive, and the work generally uneven and unsatisfactory The mechanical filler obviates all these difficulties. By its use each machine dispenses with the labor of from thirty to forty men, and fills the plates uniformly and far more effectually than can be done by hand. It is the first and only machine of the kind that has ever, so far as we can learn, been invented or claimed to have been invented, and as it is both novel and highly useful, we deem the validity of the patents unquestioned. These patents have about sixteen years to run."

CORRESPONDENCE.

New York Notes.

NEW YORK, June 19.—The startling fact of another explosion at the intersection of Broadway and Fulton street, Wednesday, with the attendant damages to business houses in the immediate vicinity has caused Commissioner Gilroy, of the Department of Public Works, to write to the mayor denouncing the Steam Heating company as a public nuisance. Hatter Knox has sued the company for $50,000 damages to his store and building, while James Mack suffered so much damage from the last explosion that his restaurant is entirely uninhabitable and the employes narrowly escaped being parboiled by the steam. Public indignation at this state of affairs is such that the franchise of the Steam Heating company is endangered and unless such a system is possible as shall not interfere with the already existing mass of gas pipes and electrical conduits in the lower part of the city, the steam heating apparatus should be done away with. Commissioner Gilroy, after a careful statement of the facts in the case and suggestions as to remedies, adds:

"Unless the suggestions as to the control of the Steam company's pipes shall be consented to by said company, steps should be taken for the revocation of the company's charter or franchise, at least so far as that part of the city south of Chambers street is concerned, on the ground that the company's business as now conducted there is a common nuisance prejudicial to public health, destructive of property and actually dangerous to life."

A meeting of the Board of Electrical Control was held at the mayor's office Wednesday. In spite of the selection of a route for rapid transit through Fourth avenue and Elm street by the commission appointed by the mayor, the board granted the subway company permission to build a subway in Elm street, and in Fourth avenue from Fourteenth to Thirty-second. It is a certainty that these two interests will seriously interfere with each other in underground construction. The denial of applications to string overhead wires and the revocation of permits for subways which did not come within the operations of the commissioner of public works was simply a repetition of previous records. No new permits were granted which would interrupt the progress of repaving or which would result in the tearing up of any new pavements in the construction of subways. There was much disappointment that the experts and engineers of the board did not render a report of the result of their investigation of the explosions in Broadway as it was supposed that the mayor called the meeting for this purpose. The interference of the steam heating pipes with the electric lighting conduits is worthy of a thorough investigation, and it is the duty of the board to insist upon fair play and give the electric lighting companies a recognition in view of the dangers accompanying steam heating in the streets. Police Commissioner Voorhis presented his claims again for a separate conduit for police wires, but his efforts, though strenuous, were without avail and the board refused to grant his request.

The decision of the Court of Appeals that the act of the legislature last year permitting any railroad company to apply to the railroad commissioners for leave to change its motive power on the consent of one-half of the property owners is constitutional, puts a new aspect to the street railway business and the cable railway men have through their efforts made the prospect for electric traction in New York very bright. They have not only secured the right to build a cable system on Third avenue but any other street railway company in the city can change its motive power by obtaining the consent of one-half of the property owners. One of the most desirable routes for the electric system would be through Eighth avenue to Fifty-ninth street and thence up the Boulevard as far north as is desirable to relieve the west side residents. This route is destined to be the popular thoroughfare for driving from down town to the upper part of the city and in no street in New York could an electric system be better operated than in the Boulevard.

It now looks as if New York was fairly certain of getting a system of rapid transit, and the genuine relief which it will bring will be an enduring testimonial to Mayor Grant and his commission who have given their personal attention to the solution of this great problem. The route is determined upon and the construction will be partly underground, and it is thought that the Vanderbilts will give their consent to use their great viaduct above Forty-sixth street for the extension of the line into Westchester and the remote districts above Harlem river. In this manner lower New York will be brought into close connection with the upper resident portion. The suggestions of Mr. Steinway in regard to the use of electricity in the lighting and motive power will be considered, and electricity is undoubtedly destined to play an important part in this new enterprise.

It is reported that the final step to prevent the execution of murderers by electricity will be taken by the Westinghouse company in which they will get a writ of replevin to obtain again the three dynamos which Harold P. Brown purchased for the state. The right to operate a dynamo in another district from which it was originally run is subject, it is alleged, to the approval of the patentee and inasmuch as it is claimed that Brown illegally and fraudulently obtained the possession of these dynamos, it will prove an interesting question if carried into litigation by the Westinghouse people as reported. W. H. T.

Nashville, Tenn.

NASHVILLE, June 20.—The advantages offered by the Southern states lying east of the Mississippi river for the development of electrical industries in all lines are known to but a limited number, and fully appreciated by none. Of all the wonderful progress made in recent years in other industries none has equaled that of electricity, and the field broadens and becomes more promising every week There is no section of the world that offers better inducements to manufacturers of electrical machinery and appliances, for the simple reason that it is virgin territory and burdened with fewer monopolistic franchises and protected corporations to be fought through the courts and the legislatures, or to be bought out at fictitious prices.

The history of the introduction of electricity into Nashville would, if fully written, furnish a key to the entire situation, and convince the most conservative that the next few years will witness an astonishing progress in the rise of this comparatively new industrial factor. A brief review of it is necessary to show what formidable obstacles have been overcome and the way made clear for future operations.

This is among the oldest, most important, commercially and financially, and third in population of the cities in the section above named. Being an important military post it emerged from the war with probably the worst municipal government ever known in the South. Ruled for years by scallawags, ward bummers, saloonists and their irresponsible following, her most valuable franchises were given to the members of the "ring" for long terms with a lavish prodigality, thus making it difficult and expensive, and frequently impossible, to establish improvements A powerful gas monopoly, with an iron-clad charter and paying enormous dividends on a very poor service, fought off all new comers for years. Mule car lines held a monopoly of all the principal streets while the telephone and the telegraph companies claimed a monopoly of pole erections. But a great change has been effected. Several years ago the citizens, regardless of political parties, rose in their might and secured an entire change of government. The existing government is a model one the city's debt has been reduced, and her bonds, bearing a low rate of interest, command a premium. The city is excellently lighted in its principal portions by electricity, while the gas company still covers the other parts.

The electric street car people had the hardest fight and gained the most signal victory. The street car service consisted of eight lines, all under separate management, and each collected its own fares. Already the last street car mule has been sent to the corn and cotton fields, and the entire system is operated by electricity, under a highly satisfactory and popular management Five lines in the city proper have been consolidated under the name "United Electric Street Car company," and give transfers from one line to all the others. Three lines across the river in East Nashville are under one management, and though they lack about fifty yards of connecting with the main system, they give transfers to all other lines, and allow the passengers five minutes to present their tickets to the transfer agent. The citizens are jubilant over this vast improvement, and testify their appreciation by a patronage that exceeds by threefold that given the mule cars.

There are fifty miles in operation at present, with about 135 miles of track. In addition to these, a new company, the City Rapid Transit company, has laid several miles of track and has purchased its rolling stock. It is restrained from further operations at present by a temporary injunction, but confidently expects to have its line in operation by the last of next month.

At the last meeting of the city council a petition was introduced asking the right of way for a new company chartered under the name of the Rock City Electric Railway company. The route asked for bisects the city from north to south and from east to west, embracing both sides of the river, and covers a running distance of more than fifteen miles Most of the line is on streets not covered by other lines, and quite a large proportion passes over private property. The petition is signed by seventeen of the wealthiest and most influential citizens of the city.

Another company, the Nashville Electric Railway & Power company, submitted its proposed route to the Board of Public Works and Affairs last week, and that body will make a personal inspection this week. The only trouble in this case seems to be in regard to the grade of a certain street.

The Main street and Lischy avenue dummy line, built two or three years ago, was operated for a year or more, and abandoned because its operation involved a dead loss to the stockholders. It has been consolidated with the East Nashville electric car system, and has been operated by electricity at a profit for three months past.

The Cumberland Telephone company, with about 1 300 paying subscribers, has recently met with a defeat for the first time in its numerous litigations. The company enjoined the United Electric street car people from operating its lines with a single trolley wire, claiming that its service was ruined by induction, and demanding that the car company use a double trolley The result, after an exhaustive suit, and much expert testimony, was a decision that the double trolley was impracticable in this city. The telephone company is now putting up a return circuit wire on all its lines that follow or cross the trolley wires, which includes nearly all of them.

Stock books have been opened here for the Molecular Telephone company in connection with another electric corporation, to be called the Capital Electric company. The molecular telephone is claimed here to be the perfection of the old Shaver system, and is operated with a receiver and central station very much like the Bell. There is in this city a line about a mile in length operated on the Shaver telephone patent that is said to work well. Two miles is said to be the limit to which this telephone can be worked on a single wire. B.

NASHVILLE, June 21.—Capitalists of Nashville, Tenn., among them Isaac T. Rhea, vice-president of the United Electric Railway company of that city, have purchased the only street car line in Savannah, Ga., and will equip it with electric motors The streets of Savannah are very wide with a double row of trees in the middle. The houses abut on the sidewalks without any sort of door yards and the lots are only 30x90 feet, thus offering the best conditions for the construction and operation of electric car lines.

It is reported that the street car lines of Vicksburg, Miss., have been bought recently by Nashville, Tenn., capitalists and their friends and will be operated by electricity.

A colored workman employed by the Nashville, Tenn., electric light company made the superintendent, Mr. Dahlgreen, a very singular and unexpected present on the 18th of June. It was a sack full of honey bees. He found them in the hood of an electric lamp where the swarm had settled the day before. B

Milwaukee, Wis.

MILWAUKEE, June 20.—Three different companies are now in the fight for a franchise to build an electric railroad to connect the city with the Soldiers' Home. The third corporation, the Wauwatosa & Soldiers' Home Railway company, has just been organized by John Johnston, Frank R. Falk, Charles Cuppel and others, who own land in the territory that such a line would traverse. The capital stock is $40 000. The new company, like the others, would like to build on the National Avenue road, but has no present intention of going to North Greenfield, as the corporation that wants franchises to build in the city, as well as outside, proposes to do.

The original Wauwatosa line, upon which work is in progress, may in time build a spur to connect with the line that is to be constructed along the National avenue road. The other Wauwatosa railway project seems to be in abeyance for the present.

The suburban railway business of Milwaukee is assuming large proportions and new railroad schemes are continually coming to the surface. The chances are that the city, which will soon be covered by a network of electric street car lines, will have suburban railways running in

every direction. Only one such line is now in existence, but nearly a dozen have assumed definite form, some of them having been decided upon by city railways.

The Whitefish Bay dummy line is suffering heavily as a result of the running of Sunday excursion trains to the bay by the Lake Shore railway. Its Sunday business has always been the dummy line's principal source of income and the Lake Shore trains take the bulk of the Sunday crowds. It is expected that when the dummy line is converted into an electric system, and runs through cars to the various sections of the city, it will regain its popularity among the masses. The reason that so many people patronize the regular railroad is that they do not like to change cars. P.

Louisville, Ky.

LOUISVILLE, Ky., June 20.—The Louisville Steam & Electric Motor Power company has been organized and proposes to locate a power plant on Third street. Plans have already been accepted. The power building will occupy a space of 60x263 feet, and will be six stories high. It will be the pioneer building of its kind in this part of the country, and it will contain 70,110 square feet of space. The building will be so arranged as to have light on all sides, and there will be room to let supplied with power. The general construction will be of the most improved and substantial kind, and it will be supplied with the latest improvements. A number of prominent Louisville capitalists and business men are backing the enterprise. The cost of the building will be about $150,000.

This city is going to have another big electric light plant. The amendment to the Louisville Gas company's charter allowing it to sell electricity for lighting and power was unanimously adopted at a special meeting yesterday afternoon. President Morris stated that the company would avail itself of the right at once. The mammoth plant will be located on the site of the old First Presbyterian church building, Sixth and Green streets, the work of tearing down the building for that purpose having already begun.

The Thomson-Houston Lighting company, of Boston, has turned over the new plant and has turned on the lights at Big Stone Gap, Va., one of the "boom" towns. The plant is located on the island and near the point where the S. A. & O. crosses the island. The building is 81x40 feet, and at the start there are 750 incandescent burners for residences and 50 arc lights for the streets. L.

Pittsburg, Pa.

PITTSBURG, Pa., June 21, 1890.—The Whitmore Manufacturing company has lately started a mill in this city for the purpose of turning out electric light poles. The company has already a large number of orders ahead and from the present outlook it is thought that the venture will be a great success.

Within a few days, the Allegheny City Electric Light plant will commence operations and the citizens of Pittsburg's twin city are hopeful of living in one of the best lighted places in the country. The power house is a handsome brick structure with stone trimmings. It has been built to answer all the requirements of a perfect central station plant. The entire machinery is on the ground floor. The boiler room contains six Erie boilers and an equal number of Roney stokers. In the engine room are seven 100 horse power compound engines, one 50 and four 15-horse power engines of the Westinghouse type. The plant has a capacity of 3,000 incandescent and 450 arc lights. The former are represented by three 1,000-light Westinghouse alternate current machines, and the arc plant consists of nine 50-light machines of the new Westinghouse alternate current arc light system. There are two direct current exciters erected on a foundation of fine enameled brick. The switch-board is of the very latest design and its arrangement is exceedingly simple. The second floor will be used for a repair and testing department, and the offices are also in this portion of the building. The lights of the plant will be distributed throughout the city on towers of which there are so far 52 placed at different points throughout Allegheny. Arc lights will be used in connection with 25 mast arms. Although the plant has not started yet, the city government is already discussing an increase of the capacity for the purpose of furnishing the private houses and stores with electric lights.

The Essick Printing Telegraph company is about to establish an exchange in this city and expects to substitute its instruments for telephones in many cases between Pittsburg and neighboring towns.

The use of the electric mining machine in the Pittsburg coal district is rapidly becoming general. Wherever a trial has been made with the appliance, success has been immediate. At the Summerhill mines, Woodville station, there are now five Hercules mining machines in operation, and each machine is stated to mine 48 tons of coal per day. All these machines are operated with the Tesla alternate current motor of the Westinghouse Electric company. Owing to the scarcity of miners in the Monongahela Valley, the Monongahela Gas Coal company is now putting several of these machines into its mines.

The Standard Underground Cable company of this city has at last decided to remove its works out of town. The management owns a large tract of land near Brinton station on the Pennsylvania railroad, twelve miles from Pittsburg, and here the company intends to put up the works and also build a new town for the residences of the employes. The place has already been laid out in streets and avenues all of which will be especially distinguished by their electric nomenclature. There are Ampere street, Volt street, Watt avenue and so on throughout the place. The plant, it is said, will cost $1,500,000 when it is finished. The dimensions of the main buildings will be 60x276 and the other four will be 60x80 feet in size.

E. H. H.

PITTSBURG, Pa., June 20.—The Central District Telephone company of this city is about to change its quarters. The corporation now occupies the upper portion of the First National Bank building on the corner of Fifth avenue and Wood street. Recently, however, the company purchased the old English Lutheran church on Seventh avenue, and the telephone people propose to erect a very handsome seven-story building for the accommodation of their offices. The contract calls for the completion of the structure by July, 1891.

The East End Electric company of this city has for some time been engaged in drilling a well on the property adjoining the electric light plant on Broad street. The company expects to strike natural gas within a few days and thus hopes to have that valuable fuel within easy reach of the boilers. A few days ago the drilling had already reached a depth of 500 feet.

The Johnstown Electric Street Railway company is helping to renovate the devastated town by laying a double track along Main street and erecting a very handsome power house.

The Citizens' Electric Light company of Braddock, Pa., Westinghouse alternate current system, has let the contract for one of the handsomest electric light stations in Western Pennsylvania. When it is finished the company intends to add two more boilers, one 125-horse power engine and two more dynamos, one 50-light arc machine and a 750 light incandescent.

The first introduction in this city of the anti-induction telephone appliance was made a few days ago in the Eleventh ward police station. This move has become necessary for the purpose of counteracting the street noise and adds more power to the telephone.

A peculiarly funny incident occurred in Allegheny City the other night when councils met for the purpose of ratifying the contracts for lighting the municipal and town buildings by electricity. After all the different items had been gone over, it was discovered that no provisions had been made for lighting up the power house of the city's electric light, thus dooming to darkness the very fountain head of the city's illuminant. The mistake was quickly rectified by ordering the wiring of that building.

The Duquesne Traction company has just closed negotiations for the erection of its power house. As has been stated before in this correspondence, this corporation has one of the most extensive systems of street car lines in Western Pennsylvania, and the power house is going to be a structure of grand proportions. The building will be erected of brick and stone and will be about 100 feet front and 125 feet in depth. The location of the power house is at Ben Venue, on the Pennsylvania railroad.

Kittanning, Pa., is about to have an electric light plant for the illumination of its streets and residences.

E. H. H.

Kansas City, Mo.

KANSAS CITY, MO., June 21.—During the second week of September there will be held in this city the tenth annual joint convention of the Old Time Telegraphers' society, and the United States Military Corps. The former is composed of veteran telegraph operators who sat by the key when the art of telegraphy was in its infancy. The latter organization is made up exclusively of the men who served in the government telegraph service during the war. Although the two are distinct societies, they always meet together, as the members of the Old Timers are, in the main, also members of the military corps. The meeting last year was held in Louisville, and the 450 who attended were royally entertained by the old veterans of the Falls City.

There are only four regularly organized branches of the military corps, which are located in Washington, D. C., Kansas City, Omaha, and Denver. The officers of the local branch are: Day K. Smith, president; J. D. Cruise, vice-president, and D. A. Williams, secretary and treasurer. Mr. Smith is president of the National Old Time Telegraphers' society. Barney Hughes of Memphis is vice-president and W. J. Dealy of New York, secretary and treasurer. The officers of the National Society of the United States Military Telegraph Corps are: W. R. Plum of Chicago, president; William B. Wilson, Holmesburg, Pa., vice-president, and J. E. Pettit, Chicago, secretary and treasurer.

The military corps has for the past few years been making an effort to have Congress in some way recognize its service during the war. Several bills have been introduced at various times in the lower house, but they have eventually been lost sight of. The National committee appointed at the last convention to look after this congressional recognition is composed of W. J. Dealy, chairman, New York; E. Rosewater, Omaha; W. B. Wilson, Holmesburg, Pa.; J. H. Emerick, New York; L. C. Weir, Cincinnati, O. The local branch is putting forth every effort to entertain their guests here in a fitting manner. An excursion to Excelsior Springs has been arranged, and a banquet will be held at "The Elms" on the evening of that day. Fully 400, and perhaps 500, will attend. P.

THE ELECTRIC LIGHT.

An electric light plant is contemplated at Buckhannon, W. Va.

The United Edison company has closed a contract for a 550-light plant at Morrison, Ill.

Falls City, Neb., has just contracted for a new alternating plant of 600 lights, Brush system.

The Jasper Electric Light & Power company of Jasper, Mo., has been incorporated; capital stock $150,000.

The installation of the 600-light Edison plant at the Southern Indiana Hospital for the Insane at Evansville, Ind., is completed.

The Hamilton Electric Light company of Hamilton, O., has contracted for a 500-light Westinghouse alternating current incandescent dynamo for its plant.

Hiawatha, Kan., is to have an electric light plant of 500 lights. The Westinghouse system of alternate current incandescent lighting will be operated in the plant.

Vinton, Iowa, is one of the latest central station plants to be furnished with the Westinghouse alternate current apparatus. This plant will start with a capacity of 500 sixteen-candle power lights.

Marceline, Mo., has decided to bond the city to buy the electric light plant of the Thomson-Houston company that has been in operation for the last year. The proposition was carried by a vote of 7 to 1.

The Westinghouse Electric company has received the contract for the installation of an alternating current dynamo of 750 lights in Saginaw, Mich., where an electric light company was recently organized.

Articles of incorporation of the Lebanon, Mo., Electric Light & Water company have been filed for record. It is composed of St. Louis capitalists, and has a capital stock of $100,000. The company will assume the contract to furnish light for the city.

The San Jose Construction company has applied to the San Jose, Cal., trustees for a conduit franchise. The company agrees to expend $10,000 within twelve months, and pay the city 2 per cent. of its net earnings; also to furnish city free use of conduits for city wires.

The Evansville Gas & Electric Light company of Evansville, Ind., contemplates extensive improvements in its plant. A new building is to be erected, additional dynamos are to be installed, and a new 500 horse power engine will be put in. It is stated that the improvements will cost about $100,000.

President Moran and Manager Fitzgerald of the Detroit Electric Light & Power company, have been served with papers in a suit begun by the Brush Electric Light company, charging that the towers which the Detroit company proposes to use are infringements on those on which the Brush company owns patents.

The electric light has evidently found favor in the state of Washington. A company which started in the town of Tacoma less than a year ago with a 750-light plant has already been obliged to make arrangements for an increase of its capacity. A contract was awarded the Westinghouse Electric company for alternating current apparatus of 1,500 lights' capacity.

The Citizen's Gas company, Rochester, N. Y., recently announced to the city council that inasmuch as the gas lights in the streets were confined to the outlying districts since the introduction of electric lighting it was found necessary to charge more for each gas lamp. The light committee of the council decided to replace a number of the gas lamps referred to by electric lights. Should the gas company persist in its claims it is probable that incandescent lamps of 300-candle power will be substituted.

A few days ago the Westinghouse Electric company received cable advice from England that it had been awarded the contract for furnishing a complete outfit of its alternate current apparatus for the establishment of a plant in Barnsley, Yorkshire. At a recent meeting of the town

councils, that body decided to discontinue the use of gas as an illuminant. The plant is to have a capacity of 6,000 sixteen candle power incandescent lamps and one hundred arc lights of the new Westinghouse alternating current arc lighting system.

It was hoped that the Edison company would soon be able to begin work in San Francisco, but it now appears that it will not secure a franchise under the present application. It is claimed that in its present form the franchise will permit the use of overhead wires; that there are no specifications whatever about the place in the street where these conduits shall be laid, or how deep or in what manner the work shall be done; that the usual bond as security against damages to property owners is not provided for, and no time is set for beginning work.

Building operations in Chicago promise an unusually lively time for electrical construction companies and manufacturers of electrical apparatus. Last week a building permit was issued for the new Masonic temple which will be 18 stories high. The building will cost above $2,000,000 and will be lighted throughout by electricity. The Northern hotel company, which will construct a fourteen-story structure on Dearborn street, Chicago, will put in a large electric light plant. A new theater on Jackson street is also one of the early futurities, all of which goes to show that there will be unusual activity in electrical circles in Chicago, for a few years at least.

Perhaps no more significant evidence of the onward march of civilization could be afforded than the lighting by electricity of the palace of Guikwar of Baroda in India, that, too, on a scale of unstinting splendor, says an exchange. The interior is lit with 215 sixteen candle power incandescent lights. The large hall is illuminated with two large twelve-light electroliers, made in bronze and lacquered work, while the light is softened and diffused by dioptric shades. Single lights are also pendent from the ends of the columns of the gallery. In the numerous rooms are three and four-light electroliers, made in a variety of designs to suit the surroundings.

The employment of the electric light on steamers traversing the Suez canal has greatly facilitated work there according to the English consul at Port Said, who gives a detailed account of the great saving that must have resulted to steamship owners from the use of the new light. The new regulations for the use of electric light came into operation on March 1st, 1887, and since then the number of vessels traveling by night has increased remarkably. In 1887 only 395 steamers used the electric light, but in 1888 the number rose to 1,611, and in 1889 a total of 2,445 vessels so navigated the Suez canal. Mail steamers only were allowed to make the night trips before the introduction of electric light.

A dispatch from Yankton, S. D., says: Yankton usually so amiable and peaceful, is all agog over a gas franchise. Two weeks ago the city council passed an ordinance granting to Tracy W. Pratt & Co. of Chicago the right to establish and maintain a water-gas plant within the corporate limits, and agreed to take several hundred gas lamps for a term of ten years. Last week an injunction restraining the city from entering into the contract was served on the council, and charges of boodleism against certain aldermen are openly made. The electric light company, composed of local capitalists, is kicking the hardest, and it is not improbable that the council will refuse to pay for electric lighting, and the city will go it blind for a time. The gas franchise is considered a wholesale robbery scheme, giving to the gas company all privileges for an indefinite time, without precautionary provisions for the protection of the city.

The Oakland, Cal., trustees recently called for bids for lighting the city. Only one proposition was received, the Oakland Gas, Light & Heat company having no opposition. The company said it would be impossible to secure apparatus for lighting the entire city by electricity and have the plant in readiness by the time the present contract expires. For lighting the city by a combination of gas and electricity, the company bid as follows: For the lighting of not less than 100, nor more than 140 electric lamps, including the sixty-nine lamps at present in use, each and every night until 1 o'clock a. m., in combination with gas lamps to be displaced within their illuminating radius during the time in which the electric lamps shall be lighted, 40 cents per lamp per night, and for gas lamps in combination therewith, 10 cents per night per lamp; public buildings, $2 per thousand feet of gas, and $12 per month for each arc electric light to be lighted till 1 a. m.

To those intimately associated with, or who have followed the advances made in the manufacture of gas, the increasing value of gas works property of this country is settled beyond all question, says *Progressive Age*. It is now positively known that the introduction of electricity has really cut no important figure so far as to curtail the gas output, and it is well known that since the introduction of electricity for street illumination the loss to gas companies of a few street gas lamps have, in all cases, been more than offset by the marked gains from increased private consumption, directly traceable to the demand for more light in order to equal the strong high candle-powers of the electric arc lights and the dazzling brilliance of the incandescent lamps. Reliable statistics, however, will show that there are probably, throughout the country, as many street gas lamps in use to-day as before the introduction of electric illumination for street lighting, a contrary impression having become general because of the disappearance here and there of a familiar street gas post and the substitution of an electric. The growth of American cities is so rapid that a great number of gas lights are annually erected in suburban and outlying sections.

It is announced that the alternating system has been adopted by the Russian government for lighting the buildings of Zarskoe-Selo, and the department of imperial palaces has placed an order with a St. Petersburg firm for a 50,000 watt machine and an exciter. Work on the central station will begin at once. At present the palaces, outbuildings and hospital will be supplied, and as soon as possible two more machines will be added to the installation. The main primary lead will be carried to a distance of two kilometres as an aerial conductor and from it the leads to the several buildings will branch off at eleven places, for which three transformers of 7,500 watts each, four of 3,750 each, and four of 1,875 each, will come into use. The order for this installation of transformers was given in consequence of the very satisfactory results which the imperial court inspectors had obtained after a year's experimental working at St. Petersburg. The experimental installation serves for lighting the Imperial Marien Theater. By the adoption by the imperial court of the transformer system with aerial leads, a question which has been for some years at issue is decided for Russia. A commission of specialists appointed by the government had been engaged with the question whether the use of aerial leads for high tension alternating currents should be officially permitted or suppressed. But up to the present date the commission had arrived at no conclusion, though at Odessa a transformer central station with aerial leads, erected by the town, had been at work for three years. Since the imperial government has applied high tension alternating currents with aerial leads on an imperial estate, its permission in Russia, if not yet officially announced, seems to be *de facto* decided. It is likely that the transformer system will soon find satisfactory extension in Russia.

THE ELECTRIC MOTOR.

The Detroit Motor company has increased its capital stock from $200,000 to $300,000.

It is reported that the Short Electric Railway company will equip the Essex electric railway of Salem, Mass.

Negotiations are now pending with the Tacoma Railway & Motor company for an extension of the electric system out Eleventh street to the eastern boundary of Section 6.

Electric railways are booming in Tacoma, Wash. Eleven miles of rails have been ordered from Pennsylvania by the Tacoma & Steilacoom Railway company, which was recently incorporated. Work on this new motor line will be begun at an early day, and the delivery of the first of the rails will be made in July.

Articles of incorporation were filed last week by the Northwestern Street Railway company of Omaha, Neb. The capital stock is $100,000. In its right of way is included nearly every street in the city. The cars will run from Wilcox's addition on the south to a point beyond the present past site on the north. The incorporators are C. F Goodman, O. P. Goodman, H. J. Penfold, Hiram G. Bell and Joseph Bell.

The Union Depot Railroad company of St. Louis put a force of men at work last week to erect poles and electrical equipment on Broadway northward from Pine street to Christy avenue, for the loop of the line running up to Union Market on Broadway and back on Sixth street. The work will be completed in a week or two. The branch of the Union Depot line extending to Tower Grove park is now operated by electricity.

The work of cable construction in St. Louis, which on certain streets has stopped the running of the electric road, is now about completed, and the St. Louis Railway company expects to send its cars out again the last of this month. If permission can be had from the city council, this company will place on the line several of the Short Electric Railway company "flyers," one of which is in daily service on the Brooklyn line in Cleveland, where, after more than a year's trial of electric traction, the public demand greater speed than is allowed on the streets of any other city in the United States.

The Aberdeen & Hoquiam Electric Railway company have been granted a street railway franchise, and will commence the construction of an electric street railway system in Aberdeen, Wash., and extend it to Hoquiam, four miles distant. By the terms of the franchise one mile of the track must be ready for operation in three months, and all of it—six miles—in twelve months. The lands between Aberdeen and Hoquiam being subject to overflow by high tides, and covered with timber, there is no communication except by water between the two towns, and this electric road will not only answer the purpose of rapid transit, but open for homes a large scope of country now unoccupied.

The Muskegon, Mich., Railway company, after a few weeks' trial of the electric road equipped by the Short Electric Railway company, has given orders for two extensions of the main branch and will have the Lake Michigan line put in operation at once. The Muskegon Heights division will be started as soon as the Short company can get out the apparatus, while a third extension to tap the factory end of the town will be completed by fall. When the electric road had been in operation a few days, the application of the railway company for an extension of franchise was granted by unanimous vote, and the company requested to choose its routes, an invitation which it has not been slow to accept.

According to the San Francisco papers, Michael Skelly, superintendent of the North Beach and Mission street car line, reports that the road will be transformed into a cable system. The company has a franchise for a route from East to Folsom street, along the latter street to California avenue, on the extreme southerly end of the city. This is exclusive of the cross-town route, which begins at Bay street, and terminates at Townsend. The other department of the road extends from East and Market streets, up California to Kearney, where it is to join the line from North Beach. The present line will also be operated by cable. The change in the roadbed and equipment will cost about $2,000,000. The plans of the road are not yet completed, and the *Pacific Lumberman* says: "We do not think that a cable road will be built on this line. Electricity will probably be used."

A St. Louisan makes this comment: "There will soon be over 100 miles of cable and electric roads in St. Louis, and the old mule is going to have a rest. But the mule, with all his faults, seldom goes very fast and is always willing to stop very promptly. Hence very few people have got run over by cars propelled in the old style But in the new rapid transit system the danger is increased in proportion to the increased speed. Most of the cars have a fender to catch those who happen to fall on the track, but the safeguard does not seem to act when it ought to. An inventive genius has devised a fender which seems to be a street sweeper and a saver of human life at the same time. It has a strong rubber guard ahead of it, and although the rubber will give way to rocks and stumps, it is rigid enough to push a man, woman or child out of the way. It would be very fortunate for mankind in general, and street car riders in particular, if the invention should turn out a success and be generally adopted."

A Melbourne, Australia, paper announces the trial of one of the new Reckenzaun cars on the Sandhurst & Eaglehawk Tramway company's line. The trial, it is said, was entirely successful. The machinery consists of two 8-horse power Reckenzaun motors, each driving an axle through the medium of worm gearing. The motors are collectively capable of yielding 24 horse power. The field magnet coils of each motor are divided into four equal sections, which, by means of a commutator, may be coupled in a variety of ways, so as to produce four different speeds and powers. The motors are placed under the floor of the car, being only 26 inches long, 22 inches wide, and 12 inches high. The storage cells are 72 in number, each made up of 17 plates, giving a capacity of 160 ampere-hours. They weigh, with tray, etc., two tons. The car, when loaded with 30 passengers, requires five electrical horse power, to run at seven to eight miles per hour, and nearly four times that power on a grade of 1 in 15 rise. The car is beautifully finished, and lighted by incandescent lamps. It was equipped by Stephens, Smith & Co. of London

The city of Richmond, Va., will always be remembered by street railway men as being the place where the superiority of electricity over other methods as a means for propelling street cars was first demonstrated. Although the apparatus installed at Richmond for street railway work was almost the first which had been designed for operating a street railway of any considerable size, the results were such as to call forth the admiration of street railway and electrical engineers, and was the direct precursor of the great impetus in electrical equipment which has since followed. Experience has taught a great many things, and there have been a large number of changes made in the design of electrical apparatus, but it is interesting to note that Richmond is still enthusiastic over electric traction, and that the two other important roads in the city of Richmond—Richmond City railway and the Richmond & Manchester railway—have decided to supplant animal power by electric power. These contracts, the one with the City Railway company being for ten cars, and the Richmond & Manchester company being for five cars, were closed by the Sprague Electric Railway & Motor company last month.

Rochester N. Y. has long been a leader in electric lighting and power, and now it bids fair to become as distinguished for its electric railways The first road, built by the Thomson-Houston company, connects the city with Ontario Beach, the favorite summer resort of that section. So successful was the operation of the line that it was determined to substitute electric motors for horses on all the city lines, and accordingly an order was placed with the Short company, which is now building the motors. The reconstruction of tracks and the erection of the overhead wires is now in progress, and within a few months it is hoped several lines will be in operation. During the last year companies have been organized for the purpose of building electric roads between the city and several favorite resorts which are within easy reach of the Flower City. The last and most important undertaking has just been announced. It is the substitution of electricity for steam on the Bay railroad. This line has been operated by dummies and the people of that city object to further use of steam since it has been demonstrated that electricity can be successfully applied to long railway lines. Commenting on this movement a local contemporary says: "Electric motors for the Bay railroad trains It is a good suggestion. These suburban lines should be run by electricity wherever it is feasible. The hissing, snorting, screaming iron horse was well enough in his day and he is still essential for extensive railroad traffic, but short passenger lines can now very well dispense with his services. In time he will follow the honored and reminiscent coach horse and the still visible street car horse into a state of innocuous desuetude. The day is coming when electricity will carry our freight as well as passengers at lightning speed across the country; when it will be harnessed to the wheels of our steamboats and great ocean steamships; when it will run the machinery in our factories, propel our bicycles, tricycles and carriage and furnish heat as well as light for our homes. The world has had its stone age, its bronze age and its iron age. It is now in the age of steam and steel; but it will not be long before the age of electricity and aluminum will relegate steel and steam to the number of things once gloriously useful but no longer needed in the presence of things vastly brighter and better."

THE TELEPHONE.

The following is taken from a recent number of the Washington *Star:* A test was made this afternoon of the electric railway signal of the Universal Electric Railway Signal company of Richmond, Va. About three miles of

the track on the Baltimore & Ohio has been provided with this signal system by way of experiment. The apparatus consists of an electric circuit formed by a single iron rod, which is laid between the tracks, and a wire brush attached to each engine in connection with an electric gong and telephone. The two engines approaching each other on the same track come into circuit at the distance of one mile and a half or more according to strength of the battery, and at once the telephone bells ring. This is a signal for the trains to stop, and the engineers may talk with each other on the telephone to discover the trouble, whatever it may be. Two trains were sent out on the Baltimore & Ohio this afternoon with a party, including several gentlemen from Washington and Virginia, and correspondents of newspapers in different parts of the country. The tests were made and proved highly satisfactory.

THE TELEGRAPH.

Suit was brought in the Supreme court in New York last week by the Farmers' Loan and Trust company, as trustee, to foreclose a mortgage given in July, 1883, by the Bankers' & Merchants' Telegraph company to secure an issue of $300,000 divisional mortgage bonds, payable in 1913. Joined as defendants are the United Lines Telegraph company, the Postal Telegraph & Cable company and John W. Mackay. By the conditions of the mortgage the mortgager was to pay the trustee $10,000 a year for the redemption of the bonds. Only one such payment has been made.

According to a telegram from Baltimore Judge Bond in the United States Circuit court signed a decree June 12 for $4,156,385 in favor of the Boston Safe Deposit and Trust company, and against the American Rapid Telegraph company of Baltimore. This was the final decree of foreclosure and sale under a mortgage for $3,000,000, given by the American Rapid Telegraph company of Connecticut, and auxiliary companies formed under the same name in different states, to the Boston Safe Deposit and Trust company as trustees, to secure the payment of bonds issued for the purpose of improving and developing the telegraph system belonging to the companies.

The postmaster general has issued an order fixing the rates on Government telegrams for the fiscal year, beginning July 1, 1890. These rates are exactly the same as those of the present fiscal year. That is, on day messages, ten cents for ten body words, for not over 400 miles, and half a cent for each additional word. Fifteen cents for ten words between 400 and 1,000 miles, and three-quarters of a cent for each additional word. For a greater distance than 1,000 miles half a cent extra for each word added to the price of the message for between 400 and 1,000 miles. For night messages fifteen cents for twenty body words for all distances, and half a cent for each additional word.

Miscellaneous Notes.

The Joliet, Ill., Electric Clock company has been incorporated with capital of $5,000; incorporators—John Anderson, C. E. Benson and Chas. Anderson.

The National Electric Development company has been organized at San Francisco by George A. Davis, John C. Turner, Henry C. Miller, Charles D. Cushing and C. J. Fallon; capital stock, $500,000. The company will engage in a general electric, engineering and contracting business.

An electrical storm visited Cincinnati last week, and the telephone and electric light wires suffered greatly in consequence. At Vandalia, Ohio, a church was struck by lightning, and considerable damage was done. At Paris, Ky., two men were killed and others badly injured by lightning. A resident of Maryville, Ind., was killed by lightning while cutting grass.

A writer in the *Chemische Zeitung*, is responsible for the following: One evening in a stearin and ceresin, manufactory in Italy four vats of white ceresin which is a paraffine obtained from ozokerite containing about 500 kilograms each, were being stirred to cool. When the point of solidification was nearly reached, the electric light of the place accidentally went out; and, to the surprise and alarm of the rather ignorant workman, the mass of ceresin was observed to give pale sparks on the slightest motion. If the hand was brought near, long sparks nearly two inches long were obtained. The phenomenon lasted over half an hour.

A story comes from Lockport, N. Y., about the effects of lightning upon a family living near that city. Here is an extract: "The house seemed to be enveloped in a bluish, hazy light and balls of fire danced along the tops of chairs and slid over mantels or chased each other up and down a hanging lamp shade. It was a terrible sight to the members of the household. There were no lights in the house, and the terror of the inmates was greatly increased by the total paralysis of their muscles. They were unable to move and sat like mummies, fearing that their end was near. The storm lasted four hours, and as it departed the electricity vanished, and the use of their limbs and arms returned."

The following from the New Orleans *Times-Democrat* is given as an illustration of the value of the daily press as an educator on electrical mechanical and subjects. The italics are ours: "To a battery of two 20-horse tubular boilers, a 10-horse engine and boiler is temporarily connected to heat the water in them; steam is first raised in the small boiler, and a dynamo used to produce electricity. *The flues in the large boiler are filled with asbestos, the ends are connected with the dynamo, and the passage of the electricity through the asbestos heats it to an intense degree, causing a rapid raising of steam.* When the required pressure in the large boilers has been attained, the engine driving the dynamo is attached to the large boiler and the work goes on as before.

"In this way it is claimed that but 25 per cent. of the power of the large boilers will be required to furnish 40-horse power, leaving three-fourths of the power to be applied to other purposes. It is claimed that the power can be supplied in this manner to any required amount. The 40 horse power could be used after starting to start up a 100 horse power and keep it moving without any cost whatever outside of keeping up the machinery. This is the first instance on record where power could be increased; nature has always worked the other way and demanded that a stronger should work the weaker, as the 40-horse power to drive 10, and if this proves a success, as is claimed, the company have the biggest discovery ever made in America, that will rank next to the discovery of steam power itself."

The circular recently issued by Purdue University, La-Fayette, Ind., describes the course of study in electrical engineering in that institution and the advantages to be derived by those who follow it. The new electrical laboratory was illustrated and described in the WESTERN ELECTRICIAN, June 22, 1889. President J. H. Small says: "To meet the demands for instruction in the industrial applications of electricity, the trustees of this institution offer to its students a special and complete course in electrical engineering. An appropriation by the state for the purpose has made possible the starting of the school on a liberal basis, and it is believed that the institution now offers opportunities in this department not excelled. The building has been designed and constructed for the department, and is supplied not only with rooms for the elementary experiments, but also with rooms and piers for the most advanced and delicate investigations. A steam engine of 22 horse power is devoted solely to the use of the department, and a series of dynamo machines and electric motors give the best facilities for studying the various types of machines used in arc and incandescent lighting, and for power. The Edison, Brush, Thomson-Houston, Sprague and Baxter systems are represented. A compound wound dynamo, designed in the department especially for the experimental study of the dynamo, is being constructed by students in the shops of the university. A Julien storage battery gives opportunity for studying the system. An alternating current dynamo will be available for next year. The department is well supplied with electrical testing instruments."

Personal Mention.

James P. McQuaide of New York and Miss Sara S. Parke were married at the residence of the bride's parents, Sea Girt, N. J., June 26.

Business Mention.

H. C. Whitney of the Crosby Electric company of New York, who has just returned from an extended trip through the West, reports an unprecedented business, as he has sold 55,000 cells of the Crosby dry battery since March 1. This speaks well for the reliability of this battery.

Ernest C. Webb, patent solicitor, makes the announcement that hereafter his principal offices will be located at 181 Broadway, New York City, with branch offices at 22 Cliff street, New York City, and Pacific Building, Washington, D. C. He has associated with him Edward R. Knowles, and Frederic Carragan. Mr. Knowles will have charge of the offices at 181 Broadway, and Mr. Carragan will be in charge of the Washington branch.

C. H. Holmes & Co. of St. Louis are in the market with an octagonal wood pole which will be of interest to street railway companies. Many of the larger cities compel the street railways to put up iron poles on which to suspend trolley wires, owing to the unsightly appearance of the ordinary wood pile. C. H. Holmes & Co. make their poles octagonal and tapering from 7 inches at the top to 12 inches at the ground line or within 5 feet of the butt of a 28 foot pole. It is claimed this will reduce the cost of electric railways from $1,200 to $1,500 per mile, and it is much less dangerous than the iron pole. The firm reports the sale of poles for the electric street railway of East St. Louis, Ill.

Electrical Patents.

Issued June 17, 1890.

430,128. Telephone. John H. Irwin, Morton, Pa.

The invention consists in mounting the second electrode upon an adjustable elastic weighted arm, which is free at one end, and insulated as to the diaphragm and its electrode.

The last claim reads:

"4. In a telephone transmitter an insulating block secured to the diaphragm, and carrying an elastic arm, to which is secured an electrode maintained in contact with another electrode mounted directly upon the diaphragm."

430,147. Electric Car. Louis Pfingst, Boston, Mass.

430,156. Manufacture of Incandescent Lamps. William L. Voelker, Morton, Pa.

The method consists in sealing the electric conductors into a glass support, then sealing the glass support into a lower section of the globe, then sealing said lower section to the upper section of the globe.

430,175. Combined Fire Alarm Telegraph and Gas Lighting Device. Charles H. Crockett and Chancellor C. Allen, Boston, Mass.

430,208. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

430,252. Electric Switch. John A. Norton, Bridgeport, Conn.

430,260. Arc Lamp. Alfred U. Allcock and Henri Galopin, Melbourne, Victoria.

The invention is designed to produce an arc lamp composed of a few moving parts, and having, first, an automatic feed device which imparts a practically continuous feed to the upper carbon, such device being controlled by the electric current, and, second, an automatic compensating balance for the upper carbon.

430,263. Signal for Electric Railways. Edward M. Bentley, Washington, D. C.

430,275. Magnetic Separator. Thomas A. Edison, Llewellyn Park, N. J.

430,279. Voltaic Battery. Thomas A. Edison, Llewellyn Park, N. J.

The invention consists of an electrode and a supporting frame therefor having a hinged part, whereby the electrode may be easily inserted and withdrawn.

430,280. Magnetic Separator. Thomas A. Edison, Llewellyn Park, N. J.

430,296. Insulator. Samuel Oakman, Melrose, Mass.

430,297. Underground Electric Cable. William R. Patterson, Chicago, Ill.

The invention relates to electric cables, and its object is to reduce the static capacity, and make it possible or convenient to remove the core, or the greater portion thereof, whenever such removal may be desired.

Claim 3 is:

"A section of telegraph cable filled at each end with an insulating substance, the portion of the cable between said filled ends containing air or gas held under pressure by the insulating filling."

430,320. Method of Synchronizing Alternate Current Machines. Edwin W. Rice, Jr., Lynn, Mass.

430,326. Electro-Magnetic Cut-Out for Electric Lamps. Elihu Thomson and Edwin W. Rice, Jr., Lynn, Mass.

430,327. Regulator for Dynamo-Electric Machines. Elihu Thomson, Lynn, Mass.

The first claim is given:

"The combination in a dynamo-electric machine of a demagnetizing coil or set of coils wound over the armature, and means responsive to current changes in the circuit supplied by the machine for varying the current in or the number of turns of said coil or set of coils."

430,328. Alternating Current Motor. Elihu Thomson, Lynn, Mass.

The invention consists, broadly, in arranging the motor so that as a structure its armature will have different circuit arrangements at the start from those which will exist when it is up to speed or well started in rotation.

430,329. Electric Railway. Merle J. Wightman, Hartford, Conn.

430,357. Electric Arc Lamp. Elihu Thomson, Lynn, Mass.

"Claim 6: The combination with the step by step feed mechanism of the vibratory armature, a driving-pawl, a circuit controller for the motor-magnet, a magnet and armature by whose contacts the electrodes of the circuit controller are held from movement during movement of the armature, and a spring for producing a separation of the electrodes to their full extent and independently of the motion of the parts by which the magnet and armature are detached."

430,373. Burglar Alarm. Stephen Broichgans, Milwaukee, Wis.

430,432. Electric Meter. Joseph Oulton and Joseph Edmondson, Bradford, County of York, England.

The device consists of a train of clock work having a torsion balance, the vibrations of the balance being accelerated or retarded by the current to be measured, the difference between the known normal speed of the clock work and its speed when influenced by the current indicating the amount of current consumed.

430,437. Incandescent Lamp. Frederick C. Rockwell, Hartford, Conn.

430,453. Process of Melting or Reducing Metals by Electricity. Thomas L. Willson, Brooklyn, N. Y.

430,461. Means for Preventing Boiler Incrustation. William B. Bull, Quincy, Ill.

430,462. Electric Incrustation Preventer. William B. Bull, Quincy, Ill.

430,485. Incandescent Lamp. Frederick C. Rockwell, Hartford, Conn.

430,487. Electric Crane. Alton J. Shaw, Milwaukee, Wis.

430,515. Electric Railway. Daniel B. Devore, U. S. Army.

430,551 Electric Meter. George H. Wade, Atlanta, Ga.

430,569. Coin Controlled Telephone Guard. Samuel M. Dowst and Frank H. Hosmer, Chicago, Ill.

Claim reads:

"In combination with a telephone, a gate or door adapted to close the mouth-piece thereof, a catch to engage and lock the door in closed position, a coin-chute, a bar controlling said catch and protruding into the coin-chute and obstructing the passage of the coin therethrough, and a second bar also adapted to protrude into the coin chute at such distance from the first bar that the selected coin may simultaneously contact both said bars and constitute means for transmitting movement from the second to the first."

430,580. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

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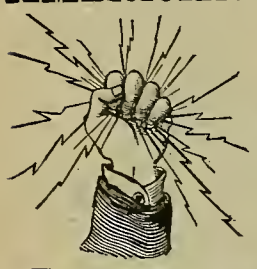

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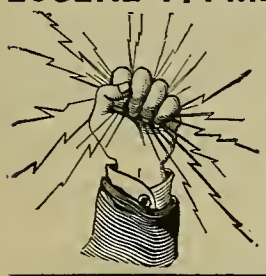

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OFFICIAL NOTICE—No. 87.

Published by authority of the Common Council of the city of Milwaukee.

WANTED--Electric Lighting.

OFFICE BOARD OF PUBLIC WORKS, Milwaukee, May 20, 1890.

Sealed proposals will be received at this office until Tuesday, July 1, 1890, at 10:30 o'clock A. M., for furnishing, erecting and maintaining 300 or more electric lights of 2,000 nominal candle power, for lighting the streets of the city of Milwaukee for a term of three years, commencing December 15th, 1890.

Such lighting, wiring and all other work necessary thereto to be done under the regulation of such ordinances and resolutions as have been or may hereafter be passed by the common council of the city of Milwaukee.

All bids must specify the kind of light to be furnished, and must be accompanied by a good and satisfactory bond in the penal sum of $50,000.00, approved as to form and execution by the city attorney.

All bids received will be submitted to the common council for consideration.

All bids must be stated in writing and in figures.

Signed, G. H. BENZENBERG,
W. P. O'CONNOR,
GEO. P. TRAEUMER,
GARRETT DUNCK,
Commissioners of Public Works.

Countersigned May 20, 1890.

FRED F. WILDE,
Deputy Comptroller.

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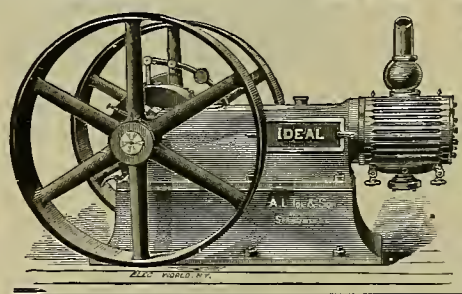

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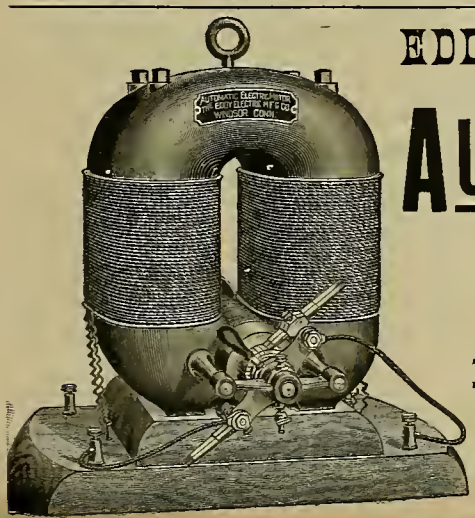

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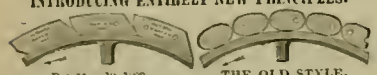

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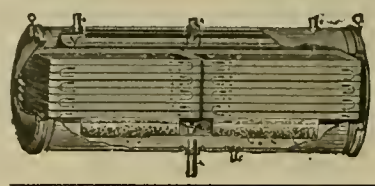

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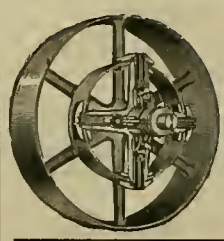

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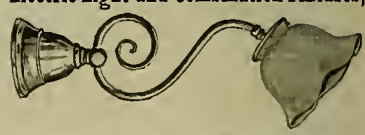

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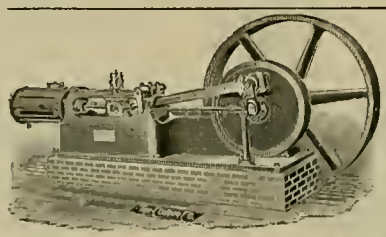

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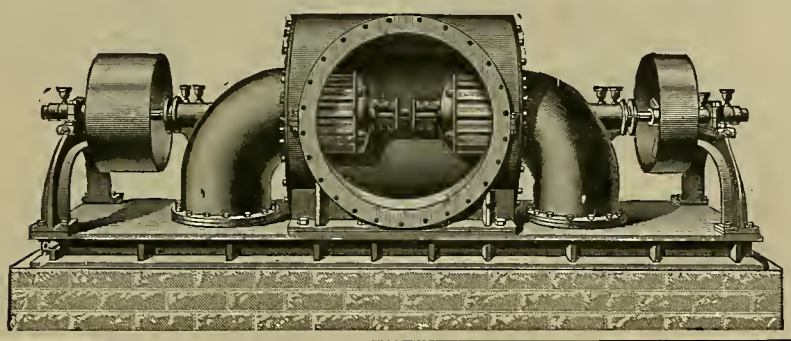

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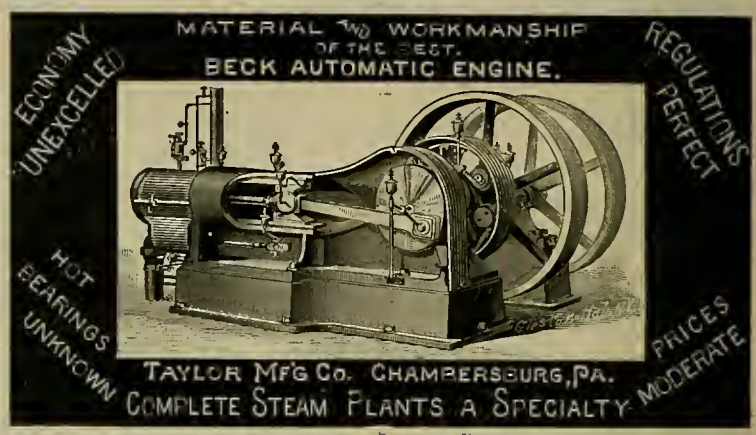

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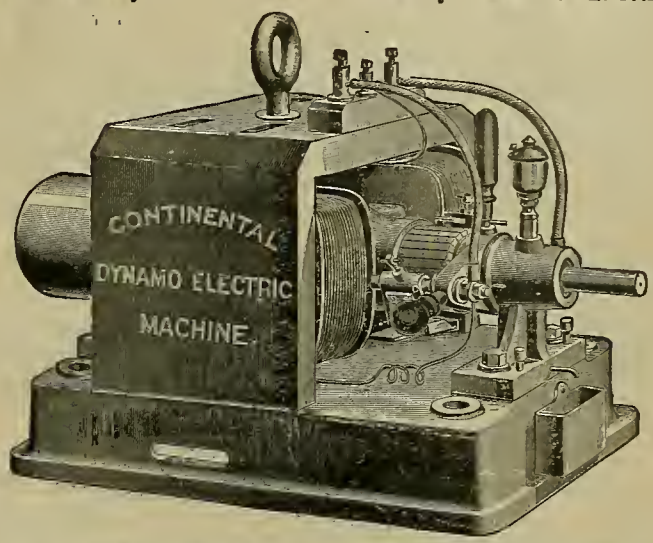

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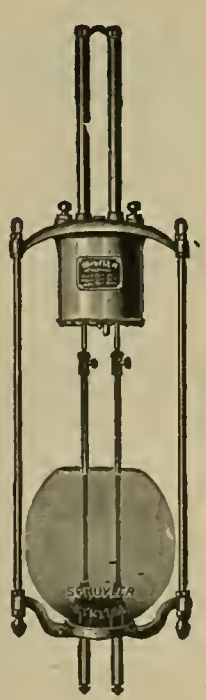

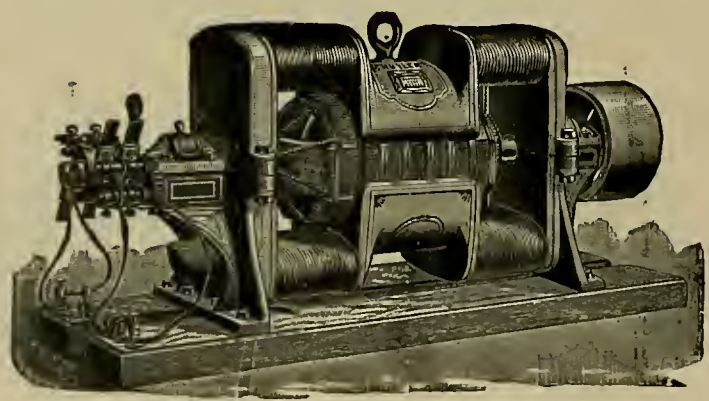

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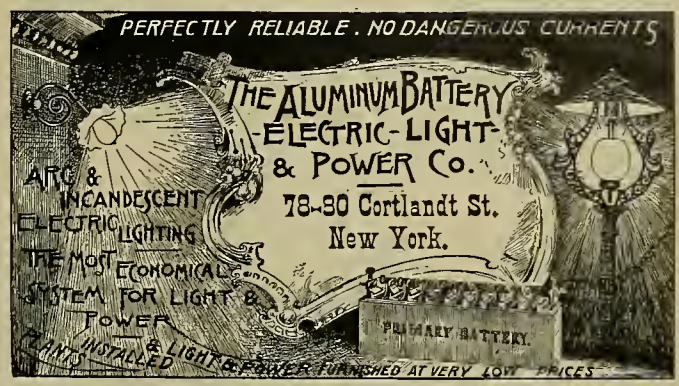

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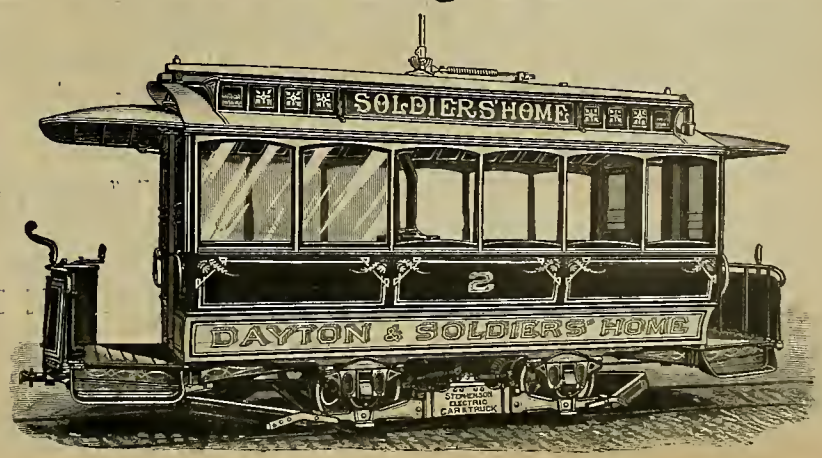

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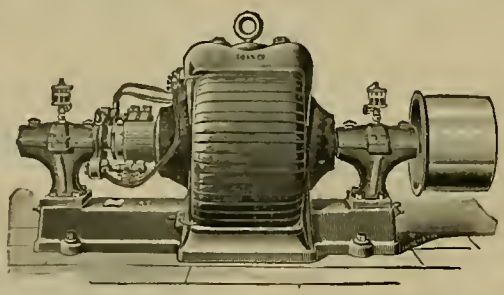

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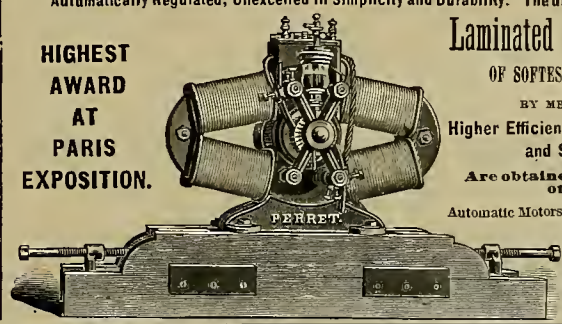

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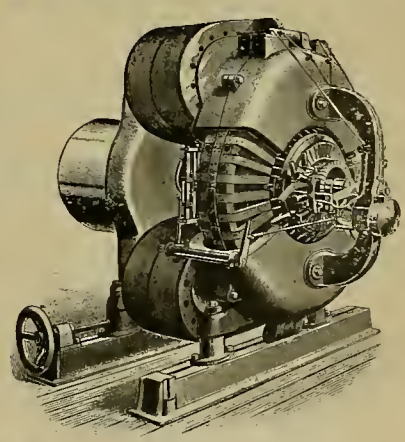

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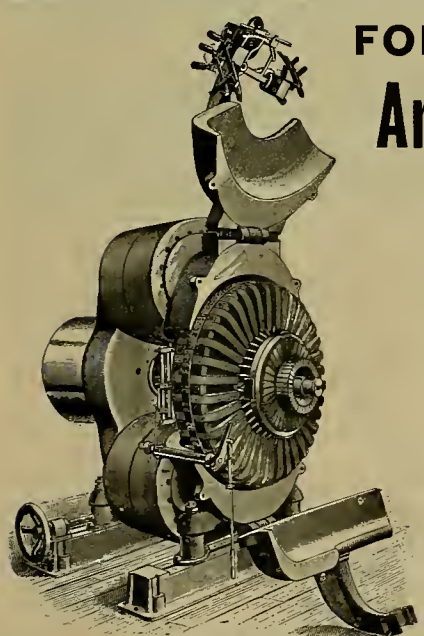

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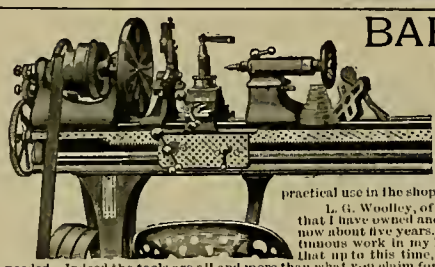

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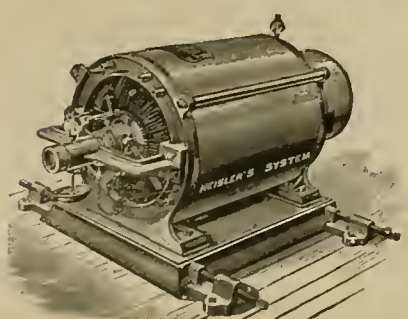

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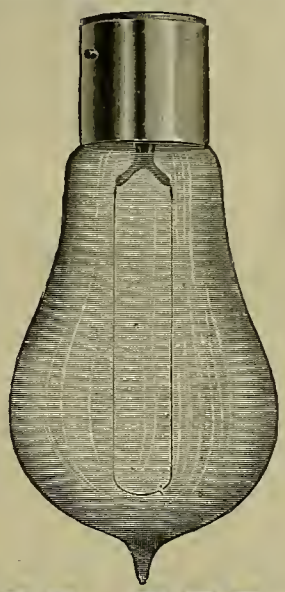

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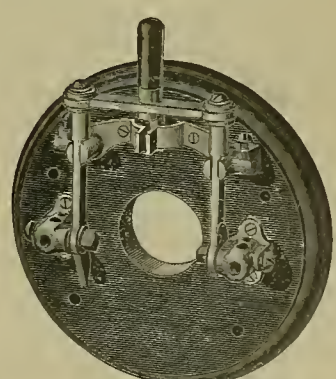

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"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

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